Railway Mechanical Engineer

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Indexes for the twelve issues of the *Railway Mechanical Engineer* published during 1924 are now ready for distribution. These are sent only to those of our subscribers who place orders for them with our circulation department, as it has been found that many of our readers have no use for them. If you wish to have a copy to include with your bound volume, or for use in referring back to the unbound copies, your order should be placed at once.

Safety appliance violations

One of the most prolific sources of violations of the United States Safety Appliance Laws is at interchange points. One road delivers cars to another with defective safety appliances and the receiving road moves them to its yard, thus making two distinct violations of the law, one by each carrier. This situation should not exist, as the law is well established that the delivering road cannot legally offer in interchange cars with defective safety appliance equipment. The law permits only such movement by the carrier on whose line the equipment becomes defective as is necessary for the repair of the defective appliance, and then only when such movement is necessary for purposes of repair. The movement to an interchange track cannot be justified as a movement for the purpose of repair. The receiving carrier cannot legally move the car, even for the purpose of repair, as it did not become defective on its line of road. The remedy for this situation lies in adequate inspection and proper repairs prior to assembling the cars for interchange movement, thereby eliminating the necessity of refusing such equipment on the part of the receiving carrier as well as the extra handling involved to make the repairs after the cars have been offered for interchange.

Fuel economy at power plants

Elsewhere in this issue is an article entitled "Fuel economy at Southern Pacific power plants," which deserves the careful study of every mechanical department officer responsible for the efficient operation of railway power plants. Many power plants need improvements which would involve considerable capital expenditures. It is also true that hardly any power plants are so efficiently operated that further economies cannot be made by the careful attention to certain minor defects capable of correction at small expense. The article referred to describes a comprehensive plan for improving the efficiency of operation of 94 stationary boiler plants located at various points on the Texas Lines of the Southern Pacific. The total cost of the oil consumed at these plants in 1923 was over $600,000, so the possibilities of saving were correspondingly great. When the work of making the improvements is completed it is anticipated that at least $125,000 will be saved annually, with an expenditure for minor improvements not exceeding $25,000.

The article is especially valuable because it shows in detail the improvements made, their cost, and the savings effected at one of the 94 terminals, namely, the passenger locomotive terminal at Houston, Texas. In this particular case the saving was $15,000 a year, or 38 per cent of the total 1923 fuel cost at that point. Some of the improvements made at Houston include such small but important items as the installation of oil-measuring meters, removal of dead-end steam pipes, insulation of boiler drums and steam pipes, repairs to dampers, installation of soot blowers, etc.

It has been said that the subject of the economical operation of stationary boiler plants is one which the railroads in general have neglected. Whether that is true or not, the experience of the Southern Pacific seems to indicate that it will pay to make a careful check at every railway power plant and ascertain if the proper attention is being given to economical operation.

Uniform location for conductor's valve

Among the subjects discussed at a recent meeting of the Manhattan Air Brake Club was "what should be the proper location of the conductor's or emergency brake valve." The interior design of many of the modern types of passenger equipment do not permit a cord from the conductor's valve to be run through the car. Some roads have abolished the cord in order to remove the temptation of an excited passenger to pull it. Thus, in case of an emergency necessitating the use of the conductor's valve, the trainman must go to the valve itself, which is usually located at one end of the car. Some of the cars recently built have a conductor's valve at each end, but this practice has not been extended to all types of equipment now being built, the design of which prohibits the use of a conductor's valve cord.

The importance of having the conductor's valve in a location of easy access to the members of the train crew should not have to be explained to any one familiar with passenger train operation. The function of the conductor's valve is in many respects the same as that of a fire alarm box in a factory or large office building. In a great many states the installation of such devices is demanded by a law, which usually provides for periodic inspection and demands that the floor space around the fire alarm box be kept clear of obstruction and easy of access at all times. This idea might also be used to good advantage in the selection of a location for the conduc-

tor's valve. Like a fire alarm box, the conductor's valve is seldom used but when it is used, it is usually badly needed.

The question of a standard location for the conductor's valve for all passenger equipment not equipped with a cord, should also be given consideration. Few trainmen take the trouble to ascertain the location of the conductor's valve in all of the cars in a train before starting out on a run and even if this were done, they would probably not remember if an emergency should arise. Perhaps if the valve was placed in a standard location for all passenger equipment considerable confusion might be avoided at an inopportune time.

The members of the Manhattan Air Brake Club have submitted this question for the consideration of other air brake clubs throughout the country, and it is hoped that consideration will be given to this important subject by the proper committee of the Air Brake Association. A number of accidents have occurred in recent years through the misuse and nonuse of the conductor's valve and there is no reason why they could not be prevented to a large extent by seeing that this valve is properly located.

Make use of the test plant

Elsewhere in this issue will be found a description of a locomotive which represents one of the most important pioneer efforts in locomotive design and proportions which has ever taken place. The principal purpose of the design is to make available the possible increase in thermal efficiency offered by the use of high steam pressure. In adapting the locomotive to the development and use of steam at 350 lb. boiler pressure, two outstanding departures have been made from the usual type of locomotive construction. One of these lies in the boiler in which a large amount of stayed heating surface in the firebox has been replaced with water tubes. Indeed both the construction and the proportions of this boiler are so different from anything heretofore employed in American practice that it would be difficult to predict just what results it will produce, either as to maintenance or steam production performance. The other innovation is the reintroduction of cross-compound cylinders, which disappeared from American practice about twenty years ago.

The real test of a locomotive is its performance in actual road service. This, and this alone, can determine the practicability of the mechanical design both from the operating and maintenance standpoint. After this has been determined, however, assuming that the verdict is favorable to the fundamentals of the new design, much more is necessary before a sound engineering basis will be available on which to make the most effective use of the principles back of the new design. In this case, for instance, it has been estimated partly on theoretical considerations and partly on the basis of experience with other types, that the special features of the new locomotive will effect a combined fuel economy of about 39 per cent in fuel consumption per horsepower-hour as compared with locomotives of straightforward conventional design and proportions.

It is tremendously important for the future development of the steam locomotive in America that accurate data be made available on which may be determined the extent to which these estimates are justified, and this data should be determined in such detail that its analysis will give a clear idea of the relative value of the different factors which go to make up the overall result. Such data can best be made available by operating the locomotive on a testing plant and, unless the preliminary road service trials prove the locomotive to be a complete failure, it will be unfortunate indeed for American railroads if complete test plant results for this locomotive are not ultimately made available.

More specialized men needed

One of the things most needed to increase the efficiency and general effectiveness of railroad mechanical departments is a larger staff of better paid, more highly specialized men in charge of the various branches of maintenance of equipment work. It is not the intention in this editorial to discuss the question of how many men a shop foreman or gang leader can efficiently supervise, although this question is a timely one and of great importance. It is of still greater importance, however, to the railroads, that adequate general supervision be provided for this department, to which is assigned the tremendous task of maintaining the cars and locomotives in this country in condition for safe and economical operation.

Without attempting to make an impression with large total figures, some idea of the magnitude of the work may be gained from the statement that on quite a number of individual railroads in the United States the labor payroll in the mechanical department for 1925 will exceed 20 million dollars, and the expenditures for material 80 per cent of this sum in addition. Statements have been made comparing the efficiency of the conduct of modern industrial enterprises and the railroads to the disadvantage of the latter. If railroad mechanical departments are not as efficient as they might be—and where is the railroad officer who would say they are—may not the trouble be lack of adequate, specialized, general supervision? What business involving the expenditure of 36 million dollars annually for labor and material would expect to conduct its affairs without a board of directors, president, series of vice-presidents, general manager, district managers and other general officers, not only exceeding in number the staff of the average superintendent of motive power but receiving vastly higher salaries?

In the opinion of the *Railway Mechanical Engineer* the average mechanical department executive in the general office is loaded down with duties in excess of his capacity to handle them efficiently and his difficulties are accentuated by the fact that the railroad is an institution primarily of length, with shops, terminals and power plants located at various points from one end of the system to the other. In other words, the officer must spread himself over a great deal of territory, spending much time in travel which the ordinary business executive can utilize by getting further into the details of his business. In view of this condition it would be reasonable to suppose that the railroads should have more, rather than less, general supervision than that found necessary in other industries.

Many instances could be cited to show the load under which mechanical department officers are expected to labor and yet produce approximately 100 per cent results. The general superintendent of motive power of one of the large midwest railroads is known to spend practically all his waking hours, usually not less than 17 out of each 24 hours, traveling, studying problems and making decisions either directly or indirectly connected with the conduct of the vast property over which he has general supervision. With little or no vacation, this man labors year in and year out and it is a continual source of surprise to his staff and acquaintances that he does not break down under the nervous strain of attempting to perform all the duties which in his opinion require the personal

attention of the officer in charge of the mechanical department.

Another case might be mentioned in which the general machine tool expert of a big railroad system is also responsible for the general efficiency of operations in all the shops. In this capacity he is installing a bonus system at one shop on the road. In addition, he sometimes instructs the apprentices, and, while it seems hardly credible, it is also reported on good authority that when an epidemic of rod failures, stoker failures, or what not, occurs, this combination machine tool expert, production engineer and apprentice instructor is sent out to investigate and report on the trouble.

The case cited may be extreme, but it certainly indicates in no uncertain way how short-handed some mechanical departments are in the general office. Let us have more specialized men, better trained and better paid, to exercise general supervision over the various important branches of mechanical department work.

Machine tools improve in design

During the past year the *Railway Mechanical Engineer* has published in its New Devices section 192 descriptions of various types of machine tools which could be used in railway shops. To one who has followed these descriptions, the progressiveness of the machine tool manufacturers in developing equipment to meet the large variety of conditions encountered in the railway shop is evident from the numerous designs of new and improved machine tools and auxiliary devices that are continually being introduced. A review of the recent developments of modern equipment shows a number of well defined trends, a knowledge of which may well prove of interest and value to those whose duties require them to make the final selection in the purchase of new tools.

The selection of a tool is first based on the primary requirements for which the tool is intended. These may be either representative production, accurate production, simplicity of design, or adaptation to a wide range of work. The efficiency of a given machine and its durability under service conditions are points that have a most decided influence upon the design and general arrangement. Consideration must also be given to the preservation of the original accuracy of alinement between important machine tool members by reducing wear and by adequate means of compensating for unavoidable wear. To obtain this result in a machine tool involves not only the design of adequate bearing surface for the use of special bearings, but effective lubrication and protection against dust or gritty material that might injure the bearing surface.

One of the outstanding characteristics in recent machine tool design has been the care given to the proper location of levers relative to the operator's normal working position. Considerable progress has also been made in reducing the number of controls as well as in simplifying their arrangement. The designers' object in focusing their attention upon these features has been to increase the output of the operator through the convenience of the control mechanism and to safeguard both the operator and the machine itself. The methods of transmitting power in machine tools either for driving the cutters or the work, or for feed movements, have been subject to constant improvement. One of the principal improvements in this respect is the use of helical gears for connecting parallel shafts. This method of gearing provides smooth transmission free from injurious vibrations. The use of special steels and heat treated gears is also becoming quite general, the hardened gears in some cases being ground to eliminate even the slightest distortions caused by heat treatment. Again, considerable attention has been given to the methods of controlling speeds and feeds. They are being simplified considerably so that operators can readily determine how to make changes, thus being encouraged to alter speeds or feeds whenever advantageous from the viewpoint of production.

Almost without exception in every machine of major importance which was described in the pages of this magazine last year the motor drive was an integral part of the machine. Improved methods of mounting the motors have been devised, in order to minimize vibrations and to make the motor an integral part of the general design. Where suitable interior space is available the motors have been installed inside the base or frame of the machines. The object of this is to protect it from dust and dirt and conserve valuable floor space. The use of variable speed transmissions of the geared type has been eliminated in certain machines by arranging the motors to give speed variations which can be used for securing different changes of speed when required. Independent motors are also being used for the movement of different parts of some machines. For example, a recent design of a heavy duty vertical boring mill includes a separate motor for power rapid traversing the saddles and tool spindles, and a planer recently put on the market has a separate motor for moving the cross rail and side head.

The hydraulic form of transmission has replaced the mechanical transmission on certain machine tools and the present trend is toward a wider application of the hydraulic type. This form of transmission is utilized with the idea of obtaining an unusually smooth action and flexibility of control that is beyond the range of mechanical transmission. This type of transmission has been utilized more particularly for grinding machines. Some applications have also been made on woodworking machinery.

In the class of service for which the average railway machine tool is used, the vibration set up in it should be reduced to the minimum. There are many methods used by the builders to eliminate vibration. One of the methods employed in accomplishing this result is the use of massive members that are much stronger and heavier than are required for strength alone. The manufacturers also have paid particular attention to torsional vibration. A car wheel boring mill was recently designed with special attention paid to the elimination of vibration. The housings are bolted, dowelled and tongued to the extension and tied together on top of a heavy box arch.

More attention is being paid to the lubrication of machine tool bearings owing to the higher speeds and bearing pressures incidental to the high duty operation required of the tools. Lubrication is accomplished in some cases by a pump and a centralized special tank with circulation to the moving parts and back to the pump. In others the splash system or an oil-tight case for submerged lubrication is used. The automatic control of the flow of cooling compounds or oils, to facilitate reloading and inspection of work, is another feature that is becoming common to certain designs of machine tools.

The review given here is necessarily incomplete. But it is evident that the machine tool manufacturers are constantly introducing designs which, in many instances, represent a vast amount of research and experiment. The railroads ultimately benefit by this research when they buy new machine tools which, if properly used, increase their production and materially reduce the cost of the maintenance of cars and locomotives.

New Books

Recent Progress in Engineering Production. *By C. M. Linley, consulting engineer. 340 pages, illustrated. 7 in. by 9½ in. Price 42 s. Published by Ernest Benn Limited, 8 Boverie street, E. C. 4, London, England.*

The cost of production is the most serious problem confronting industry today. The main direction in which economy of operation can be sought is obviously in the employment of the most up-to-date time and labor saving machines and appliances. This book contains 51 well illustrated chapters dealing with all kinds of machines and appliances used in the industrial field. It covers the products of machine tool builders of the United States and England and describes the machines built in both countries which the author believes to be best suited for the particular class of work which he may be describing. The book will serve as a reference work to those in the industrial field whose duties require them to select machines for various classes of work.

Aside from that part of the text dealing particularly with machine tools and their uses, the author has described in a general way the equipment and practices common to case hardening and heat control, metal cutting by means of machine controlled oxygen jets and has included chapters on pattern making, and the use of aluminum alloys with a brief description of extrusion processes. As a whole this book constitutes a broad treatment of modern industrial plant equipment and practices.

Arc Welding and Cutting Manual. *A 127-page, 7¾ in. by 10½ in. illustrated manual. Published by the General Electric Company, Schenectady, N. Y.*

The purpose of this manual is to acquaint the uninformed in a general way with some of the applications of arc welding, and to provide a simple and logical method by which one may acquire a certain familiarity with the manipulation of the electric welding arc and its characteristics. The volume is well illustrated with photographs, diagrams and charts, explanatory of the text. It is divided into three parts, the first devoted to general information on arc welding, the second to a training course for operators and the third giving a number of applications of arc welding.

The general information deals with polarity and the source of welding current for the arc. The characteristics of a good arc are pointed out. Considerable attention is given to electrodes and accessories. The training course for operators is a timely subject and is developed in the text in such a clear manner that it can be readily used as a framework to organize a training course for operators by those who are desirous of obtaining skilled workmen. The welding of cast iron, manganese steel, structural steel, steel and iron alloys and non-ferrous metals is taken up from all practical angles. The manual should prove valuable in practically all industries and trades.

Handbook of Wooden Car Repairs. *By E. W. Hartough, formerly general car foreman, Missouri-Kansas-Texas, Pere Marquette, 219 pages 4½ in. by 9½ in., illustrated. Price $2.50. Published by the Simmons-Boardman Publishing Company, 30 Church street.*

The author describes the construction of and the repairs made to wooden cars, gondolas, box and stock cars, refrigerators and cabooses. Sections of the book are devoted to freight car roofs and car doors for all classes of house cars, both wooden and steel.

Part I deals with wooden flat cars and gondolas. General descriptions of these cars are given, particular attention being paid to sills and attachments, car floors and timbers liable to failure. The most economical methods of making repairs are then discussed. Part I concludes with an interesting explanation of brake gear. It takes up the methods of calculating the pull exerted by levers and total braking pressure. The fundamental brake gear is described. Attention is called to the results obtained by making wrong lever combinations.

The wooden box cars are taken up next with considerable attention to the methods of repairing the car body. This is followed by a discussion of stock and refrigerator cars and cabooses. An interesting explanation is given about insulating materials for the car body. The defects developed in insulation and in car construction are pointed out with suggestions as to how to make proper repairs. The standard types of ventilators and the ventilated and heated refrigerator cars receive considerable attention. Part 5 explains the various types of freight car roofs in use today. Their defects and remedies are clearly explained. The book concludes with a discussion of the construction, defects and method of making repairs to freight car doors.

Car Truck and Draft Gear Maintenance. *By E. W. Hartough, formerly general car foreman, Missouri-Kansas-Texas and Pere Marquette Railway. 158 pages, 4½ in. by 7½ in., illustrated. Price $2.00. Published by the Simmons-Boardman Publishing Company, 30 Church street, New York.*

The work of the railroad carman is so diversified that the writing of an average size book on the entire subject of car repairs would result in many important details receiving but scant attention, or being omitted entirely. This volume deals only with the construction and maintenance of car trucks and draft gears. For the sake of easy reference, five distinct separations have been made. Sections I and II cover arch-bar truck repairs, and Section III is devoted to the subject of cast steel and pressed steel side trucks. Sections IV and V go into draft gear repairs.

The first part of the sections dealing with car trucks goes into a detailed description of the general construction and operation of a freight car truck. Mention is also made of the causes and the methods of failure of the component parts. This is followed by the more important subject of repairs, including a description of the methods and the apparatus actually employed in car repair yards to repair the damaged parts of a truck in an efficient manner. Each part of the truck is considered in detail, beginning with general operations, such as jacking and the removal of bolts and nuts, and proceeding to repairs of a more easy nature, such as those that deal with the component parts of the truck side. The section on car trucks closes with a general description of trucks with cast steel or pressed steel side-frames, rigid bolster trucks and others constructed with the purpose of evolving a truck that will possess a maximum number of advantages with a minimum number of defects. Particular attention is given to the features which provide special advantages in assembling or that secure more efficient operation.

Sections IV and V pertaining to draft gears open with a detailed description of the construction and operation of the A.R.A. standard *D* type coupler. This is naturally followed by a discussion of the various types of draft arms in use and the methods of repairing them. Spring gears are considered first including a description of the construction, operation of parts liable to failure and methods of repair of the more common spring gears in

present day use. The concluding chapters deal with the numerous types of friction draft gears and methods for repairing them.

Pulverized Fuel, Colloidal Fuel, Fuel Economy, and Smokeless Combustion. *By Leonard C. Harvey. 466 pages, illustrated, 7½ in. by* 10 *in. Price* $18.00. *Published by the Macmillan Company, New York.*

This book presents to the reader the results of a thorough and intensive study of the various applications of pulverized fuel. A large part is devoted to the describing of successful systems for handling and burning this type of fuel in power plants as well as in the metallurgical and railway industries. The author has given the underlying principles and has shown the advantages and disadvantages that are liable to be incurred in the use of pulverized coal. In this, he has presented numerous extracts from the writings of engineers and scientists of many nationalities and has also shown the results of practical work performed by experts.

The book has 17 chapters, the first six of which are devoted to a contrast of past and present day practices, a discussion of the combustion of pulverized fuel, fuel conservation, the difficulties to be encountered in handling pulverized fuel and the various systems of washing and conveying. The remaining chapters are devoted to the application of pulverized fuel to various industries. Chapter 15 gives a discussion of the firing of locomotive boilers with pulverized fuel. This chapter gives an account of the most recent applications on various railroads both in this country and abroad. It also contains the results of comparative tests run with pulverized and lump coal and gives an interesting account of the various difficulties that were encountered and eventually overcome. The remaining portion of this chapter is devoted to descriptions of the various types of equipment. The last chapter contains an appendix which includes tables and data on combustion and firing efficiency, air mixtures and water vapor, etc. There is also a list of pulverized fuel installations in various parts of the world and a bibliography of recent articles and publications on this subject. The text of the book is well illustrated with drawings and photographs.

What Our Readers Think

Reclaiming files

Cebu, P. I.

To the Editor:

In the November, 1924, issue of the *Railway Mechanical Engineer,* James Sheridan of the Copper River & Northwestern, raised a question concerning the reclamation and recutting of files. I have had some experience in the reclamation of files with acid solutions and with the sand blast machine. There are various formulas for acid solutions.

Formula No. 1—Boil the files in a strong soda solution to clean off all grease, oil or gum, then dip for a few minutes in a bath of one part nitric acid and two parts water. The length of time is less on a fine file, as experience may suggest.

Formula No. 2—Wash the file in a warm potash solution to remove the grease and dirt, then wash in warm water and dry by heat. Put 1½ pints of warm water in a wooden vessel and place the files in it; add 3 oz. of finely powdered blue vitriol and 3 oz. of boric acid. Mix well and turn the files so that every one comes in contact with the mixture. Add 10½ oz. of sulphuric acid and ½ oz. of cider vinegar. Remove the files after a short time, dry thoroughly and rub them with olive oil, then wrap in porous paper. Coarse files should be kept in the mixture for a considerably greater length of time than is necessary for the fine ones.

The above formulas are for files that are not wearing out, but only such files as have been used on soft metals, such as brass, copper and white metals. The teeth become filled up with the metals. It is believed that the most economical process for the reclamation of files is the sand blast machine.

J. T. Bootes,
Division foreman, Philippine Railway.

Using dividers to set valves

Portland, Me.

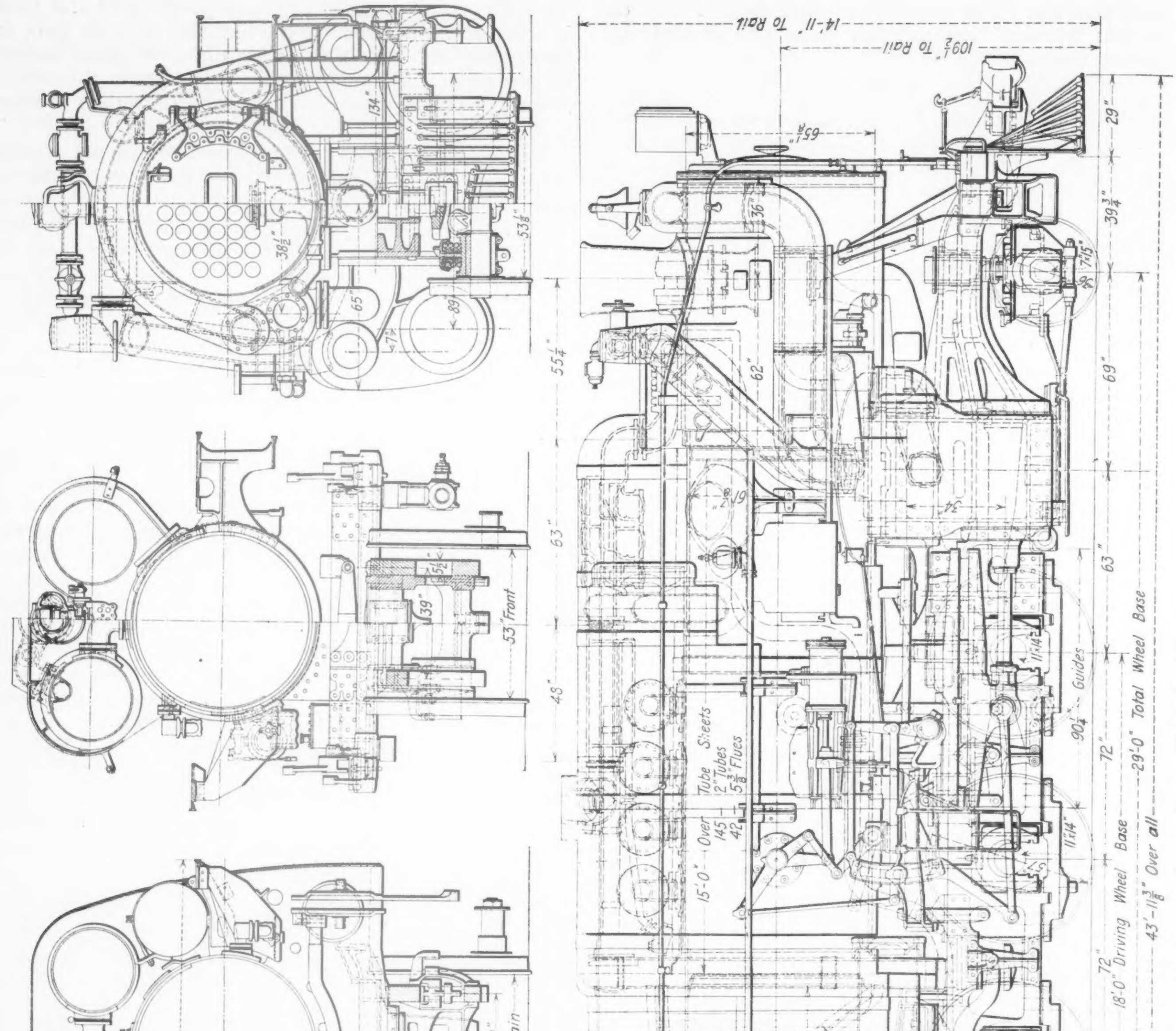
To the Editor:

I have been reading Mr. Stowell's article on "Helpful Suggestions for Setting Locomotive Valves," which appeared on page 596 in the October issue of the *Railway Mechanical Engineer.* I don't want to criticize his method but I think that the fewer figures used the less liable there are to be mistakes. I have been setting valves for ten years and do most of my work with dividers. I make it a practice of turning wheels backward, with the reverse lever in full gear ahead when getting quarter marks. After marking each dead center I roll the wheels forward and obtain the lead marks. This will give all four centers and lead marks for the head gear. Then get the lead marks for the back gear, in the same manner. The next operation is to set the crank. If it is to be set at right angles to the pin the front lead marks must measure the same distance apart as the back ones. If they do not then this is the point where the dividers are used. Let *a, b, c, d* represent the lead marks $\dfrac{a. \quad b.}{c. \; F. \; d.}$. Set the dividers *a b* and mark on a line on some convenient smooth surface $\dfrac{a. \quad b.}{c. \quad d.}$. Then set for *c d* and mark *a d.* If the lead marks are equal they will measure *a c.* Remember that we are in the back gear. Between *c* and *d* mark lightly the center *F.* Now set the dividers one-half of *a c,* and using *F* as the center, move the crank so that *c* or *d* according to the end of the stroke, will come under the other leg of the dividers.

One revolution of the wheel in each gear is usually sufficient to prove the work. If the eccentric needs to be changed, the center foreward gear marks and the reverse gear center marks must come together when correct, so move the eccentric rod according to the motion. If the engine is in direct motion in foreward gear, the reverse gear mark needs to go ahead and it follows that the crosshead must come back. To do this, shorten the eccentric rod one-half of the distance between the centers multiplied by three. (It is understood that the fixed point of the tram is on the crosshead guide and the crosshead moves under it.) After getting the lead marks right, get the port marks and move the valves on the stem by adjusting the nuts to equalize them with the lead marks. By this method the wheel roller can be put under the engine and the setting completed in one day ready for the side rods, providing of course, that there are no new main pins to have key-ways cut in.

I would like to hear from others on this subject.

W. C. Sparrow.



Elevation and cross sections of the "Horatio Allen"

The "Horatio Allen" develops 104,000 lb. maximum tractive force, including the tender booster

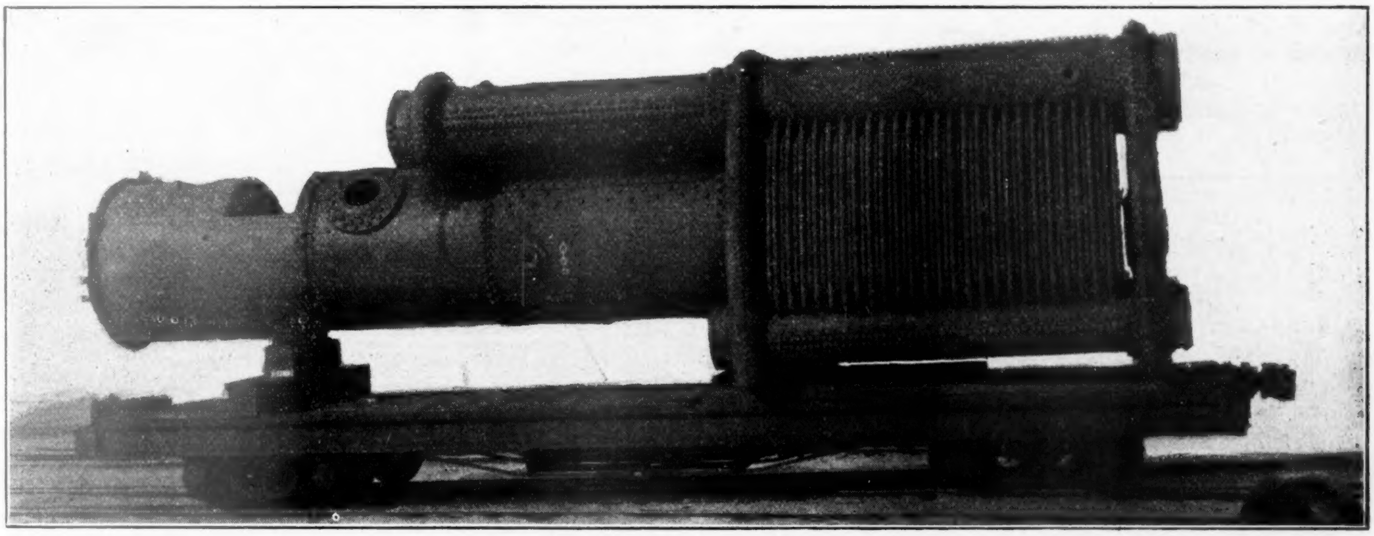
The "Horatio Allen," a high pressure locomotive

Water-tube firebox contains 37 per cent of total heating surface—Cross-compound cylinders

On December 4, 1924, the Delaware & Hudson, with ceremonies fitting the occasion, christened a new Consolidation type locomotive of unique design, the "Horatio Allen," in honor of the engineer who was responsible for the building of and was the first operator of the "Stroubridge Lion," which went into service on what is now a part of the Delaware & Hudson on August 8, 1829.

The design of the new locomotive was developed by John E. Muhlfeld, consulting engineer for the railroad, and it was built by the American Locomotive Company. Naming it after a pioneer in steam locomotive development is suggestive of its character as, in effect, it represents a pioneer attempt to increase the thermal efficiency of the locomotive by employing the greater expansive range made possible by steam pressures much higher than are now employed in conventional locomotive designs. There are also a number of interesting details of construction in which conventional design has been departed from, aside from those made necessary by high steam pressure.

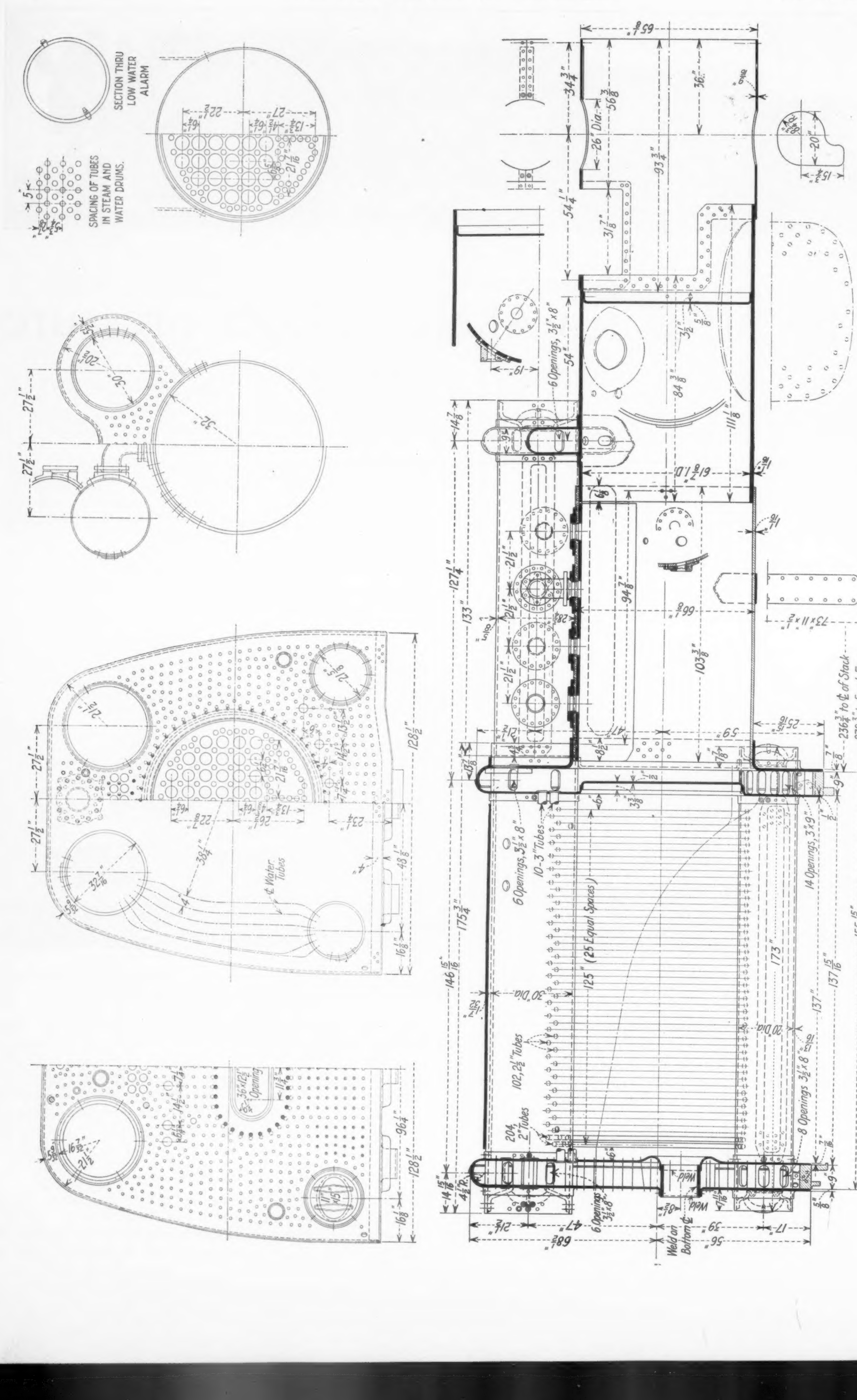
The "Horatio Allen" is of the Consolidation type weighing 297,000 lb. on the drivers, with tractive force ratings of 104,000 lb. simple including the tender booster, 84,300 lb. simple for the engine alone, and 70,300 lb. compound. The locomotive carries 350 lb. boiler pressure and works steam expansively in cross-compound cylinders of 23½-in. and 41-in. diameters, respectively, by 30-in. stroke. The driving wheels are 57 in. in diameter. In actual service the locomotive has developed drawbar pulls of 105,000 lb. at starting simple with the booster cut in; 95,000 lb. in simple gear at 4 miles an hour; 75,000 lb. in compound gear at 5 miles an hour; 65,000 lb. in compound gear at 10 miles an hour, and 53,000 lb. in compound gear at 18 miles an hour.



The complete boiler before the application of the firebox lagging—The man-hole in the front barrel course gives access to the interior in the absence of a dome

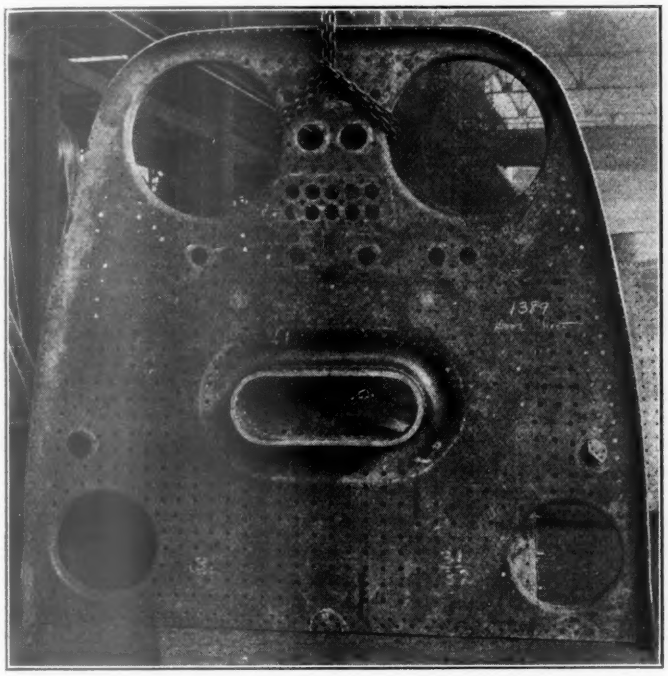
The boiler

The boiler represents a complete departure from customary locomotive design. Its construction is clearly shown in the drawings and photographs. The back head and rear tube sheet connections of the firebox are both of



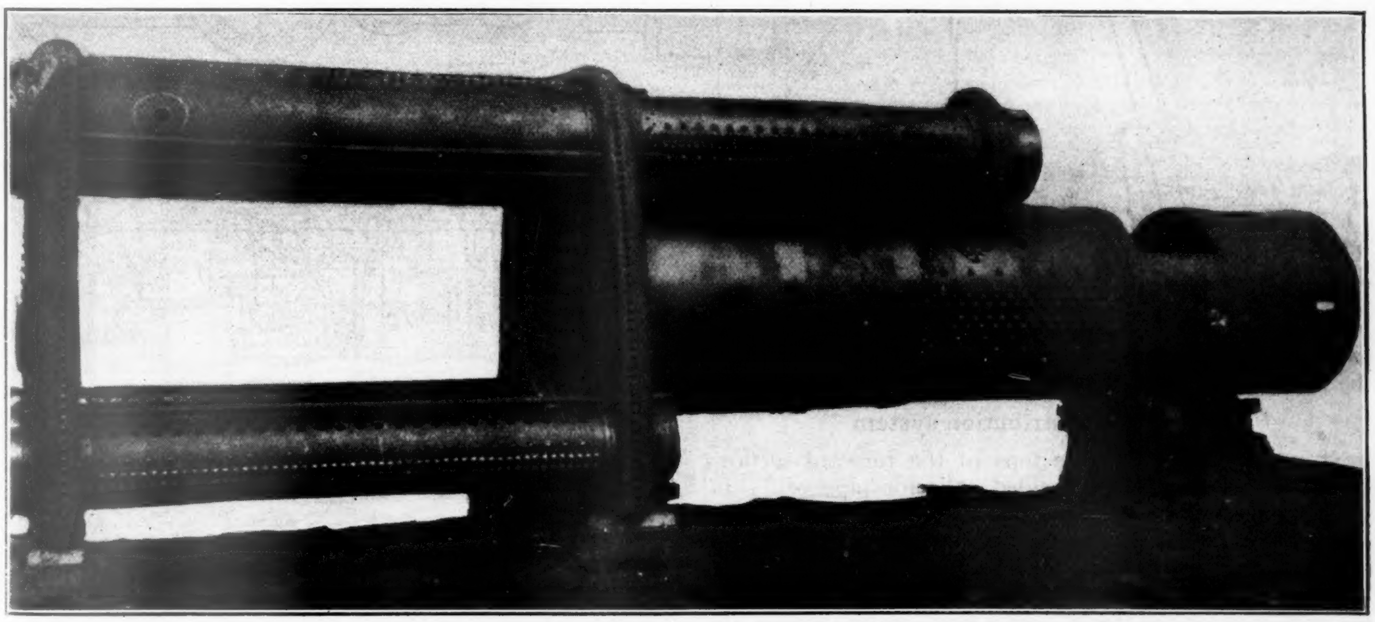
Longitudinal section, cross sections and back head elevation of the boiler

similar construction. They are 9-in, water leg headers composed of parallel stayed sheets, flanged and riveted together around the top and sides and secured to steel foundation castings at the bottom. Circular openings through each of these members near the lower corners receive water drums, 20 in. in inside diameter. These



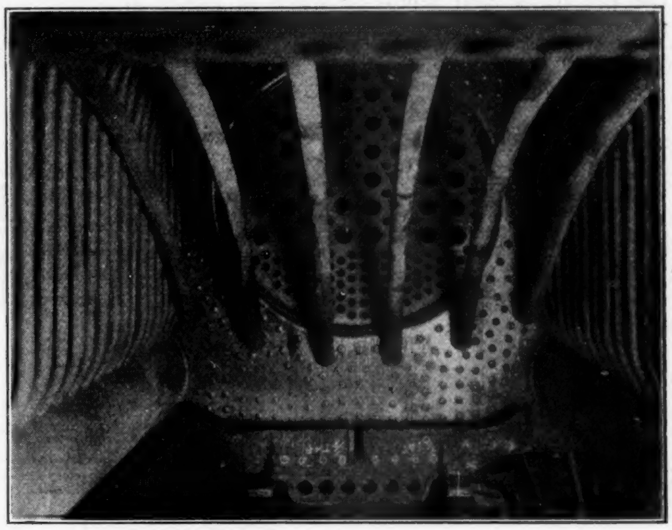
The inside sheet of the back firebox header

drums pass completely through both of the headers, and ports are cut through their shells in the header water spaces. The 30-in. steam drums at the top are secured to the front and back headers in the same manner. These drums are in two courses, the front course fitting inside



The boiler before the application of the water tubes

the rear course and extending 133 in. forward along the boiler shell. The front ends pass through a stayed saddle secured to the top of the boiler barrel and ports through the drums and through the boiler shell provide for communication through the saddle between the drums and the boiler barrel. The ends of all four drums are closed with internally projecting heads and hand-hole covers. Referring to the boiler drawing, it will be seen that four pipe connections lead out from the top of the boiler barrel between the forward extensions of the steam drums and connect alternately into the two drums thus adding considerably to the freedom of communication between the boiler barrel which is completely filled with water, and the drums, the upper parts of which constitute the steam



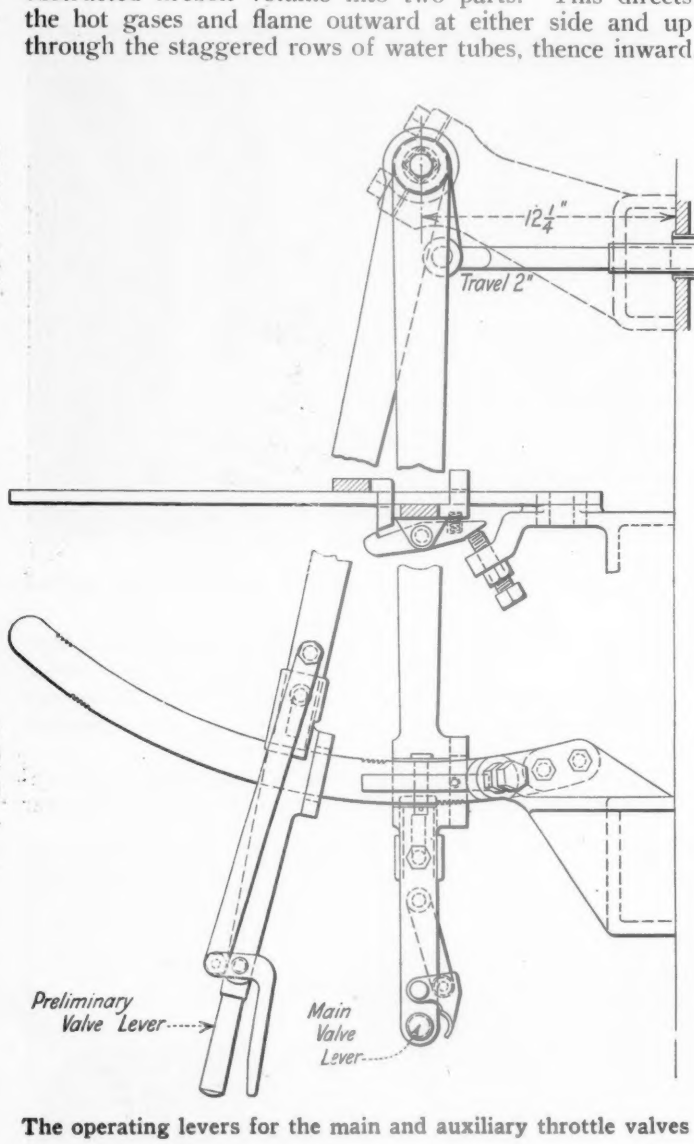
Interior of the firebox before the arch or grates were applied

space of the boiler. The front sheet of the forward firebox header is flanged outward to receive the back course of the two-course boiler barrel, which is 66⅛ in. in outside diameter. The inside sheet of this header is flanged inward to receive the firebox tube sheet.

The heating surfaces at the sides of the firebox are composed of 306 tubes, 102 of which are 2½ in. in diameter and 204 of which are 2 in. in diameter. These tubes are expanded into the top and bottom drums. It is thus evident that the amount of stayed surfaces has been considerably reduced and are flat, parallel surfaces, with the exception of the small area of the firedoor flange. The

drum and header type of construction, with the top headers carried forward and securely attached to the boiler barrel also provides an extremely rigid structure.

Additional heating surface is provided in the firebox by ten 3-in. longitudinal water tubes which lie between the upper drums and connect the front and back stayed headers. There are also six 3½-in. arch tubes. The arch in this locomotive is unbroken from the tube sheet to the door sheet, thus completely dividing the unobstructed firebox volume into two parts. This directs the hot gases and flame outward at either side and up through the staggered rows of water tubes, thence inward



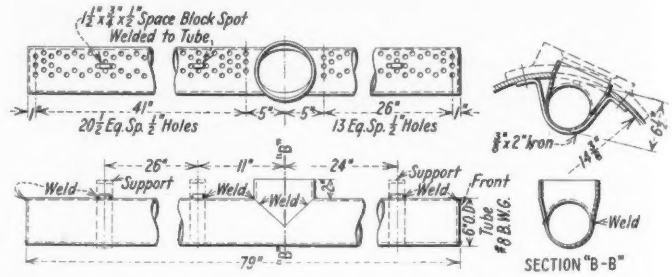
The operating levers for the main and auxiliary throttle valves

to the combustion chamber volume above the arch and into the fire tubes.

The steam distribution system

Steam is taken from the tops of the forward sections of the steam drums. A welded collector pipe of ¼ in. steel, 6 in. in outside diameter and 79 in. long, is suspended from the top of each drum. The upper surface of each of these pipes is perforated with several rows of ½-in. holes, through which the steam enters, thus distributing the gathering of the steam over a large water surface and removing any tendency for a local surge to lift the water. From these pipes the steam passes out of the drum into a yoke header casting between the drums, to the front flange of which is bolted a Sanford-Riley Stoker Company's desaturator. This is of the centrifugal type, the whirling of the steam through a horizontal spiral passage causing the water to be thrown off and collected at the bottom of the casting, from whence it is trapped back into the boiler. The front flange of the desaturator is bolted directly to the throttle casing.

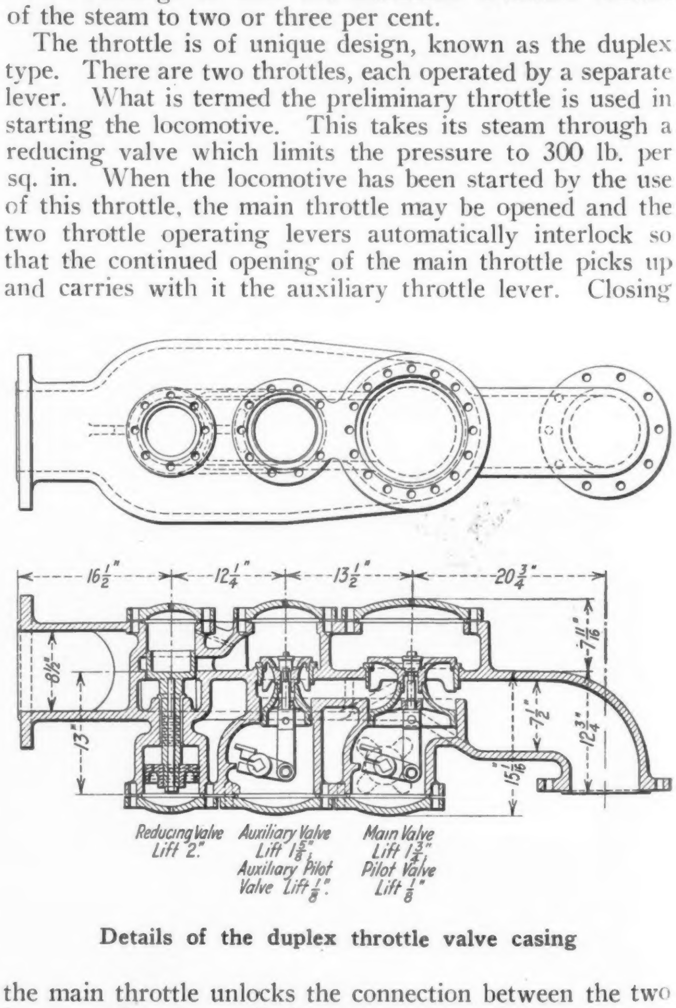
The perforated steam collector has proved so effective in service that very little water is removed by the desaturator and some question has arisen as to whether or not it is actually needed. The overall effect of both the



The steam collector—One of these is located in the top of each steam drum

collector and the desaturator has been found by calorimeter readings to limit the maximum moisture content of the steam to two or three per cent.

The throttle is of unique design, known as the duplex type. There are two throttles, each operated by a separate lever. What is termed the preliminary throttle is used in starting the locomotive. This takes its steam through a reducing valve which limits the pressure to 300 lb. per sq. in. When the locomotive has been started by the use of this throttle, the main throttle may be opened and the two throttle operating levers automatically interlock so that the continued opening of the main throttle picks up and carries with it the auxiliary throttle lever. Closing

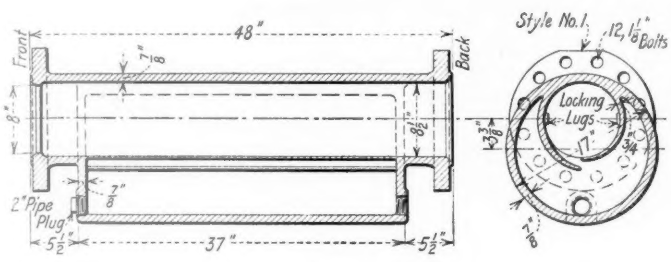


Details of the duplex throttle valve casing

the main throttle unlocks the connection between the two levers so that the preliminary valve lever is free to move independently in starting. The throttle valves are of the Chambers type.

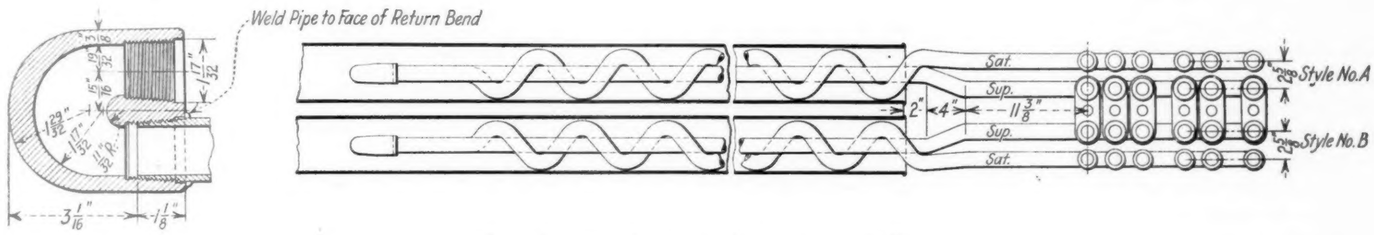
From the throttle the steam flows directly into the superheater header, which is mounted on a cast base over the top of the smokebox. The unit bolts are applied with the nuts at the top of the header, where they are accessible for tightening without opening the smokebox front. This arrangement is clearly shown in one of the drawings. There are 42 superheater units, each of which

consists of a single loop. The unit pipe leading from the saturated steam header is twisted above the return pipe in a spiral and the two pipes are threaded and welded into a cast steel return bend which is located 12 in. from the back flue sheet. The whirling motion imparted to the



The desaturator—The steam passage contains a spiral core

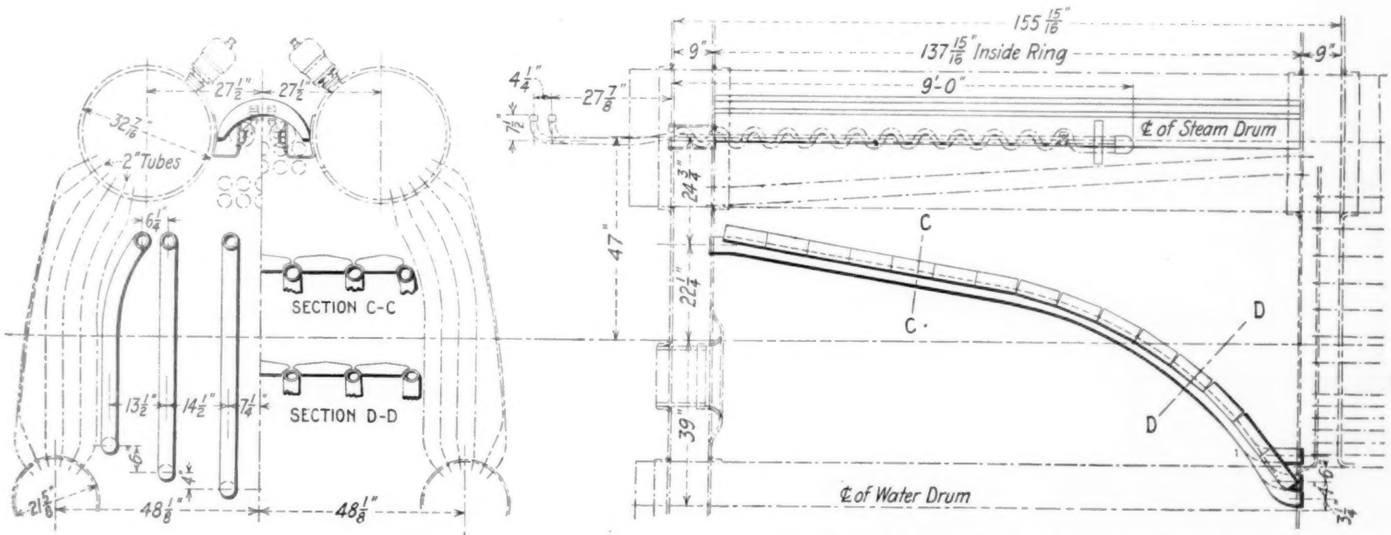
saturated steam is designed to bring such moisture as the steam may contain into intimate contact with the unit surface, thus producing a more effective heat transfer. It also serves to equalize the expansion strains on the return



How the superheater units are arranged

bend joints. Steam from the drifting valve passes through the superheater and thus serves to protect the units from overheating, when the throttle is closed.

A flange on the right side of the superheater header leads the superheated steam into a branch pipe connection to the high pressure steam chest. In the design of this



Details of the firebox arch—The location of the auxiliary superheater units is also shown

cylinder, close attention has been given to providing unobstructed flow to and from the valve chamber and special attention has been given to collecting.

The simpling of the cylinders at starting and change to compound operation either automatically at the proper speed or manually at the will of the engineman, is controlled by a Mellin intercepting valve. This valve is inserted in the receiver line and is attached directly to the exhaust cavity opening on the front face of the high pressure cylinder casting. From the intercepting valve casing the receiver pipe is carried forward and over the top of the smokebox in front of the stack, thence back to the valve chest connection of the low pressure cylinder.

The steam distribution is controlled by the Young valve gear, operating a 12-in. piston valve in the high pressure steam chest and a 14-in. double ported piston valve in the low pressure steam chest.

Considerable attention was given to the design of the steam passages to provide ample area free from obstruction. The dry pipe passage up to the throttle is 8½ in. in diameter, except for a flange at the outlet of the desaturator, which is reduced to 8 in. in diameter. From the throttle to the superheater header the passage is 7½ in. in diameter, and this size is retained through to the high pressure cylinder. The passage through the receiver pipe is 10 in. diameter.

Superheated steam for the tender booster is taken from the high pressure branch pipe where it connects to the main superheater header. Superheated steam for the other auxiliaries is also provided by an auxiliary superheater, the units of which pass into the upper part of the firebox through the tubes in the back header.

Frame and cylinder construction

One of the most interesting departures from conventional design is in the frame construction. The main frames terminate just back of the cylinders and the front rails are replaced by a combined saddle, frame and front deck casting of steel. The high-pressure cylinder is secured on the right side and the low-pressure cylinder on the left side. The smokebox saddle fit is made in a separate casting, which is bolted to the top of the main casting.

This permits the removal of the boiler without disturbing either the smokebox saddle fit or the main frame splice. The details of the main casting are clearly shown in one of the drawings.

The only steam passage cored through the steel saddle casting leads from the exhaust passage of the low-pressure cylinder to the front face of the saddle casting on the center line of the locomotive. From this point an outside exhaust pipe carries the steam forward and up into the exhaust nozzle in the smokebox. The center line of the exhaust nozzle is located 65½ in. forward of the transverse center plane through the cylinders.

Other details

One of the drawings shows the detail construction of the exhaust nozzle. This provides a direct passage for the low pressure exhaust, the diameter of which is 10 in. at the base, reducing to 8¼ in. at the nozzle tip fit. The diameter of the tip at the outset was 5½ in., although this may since have been subjected to adjustment.

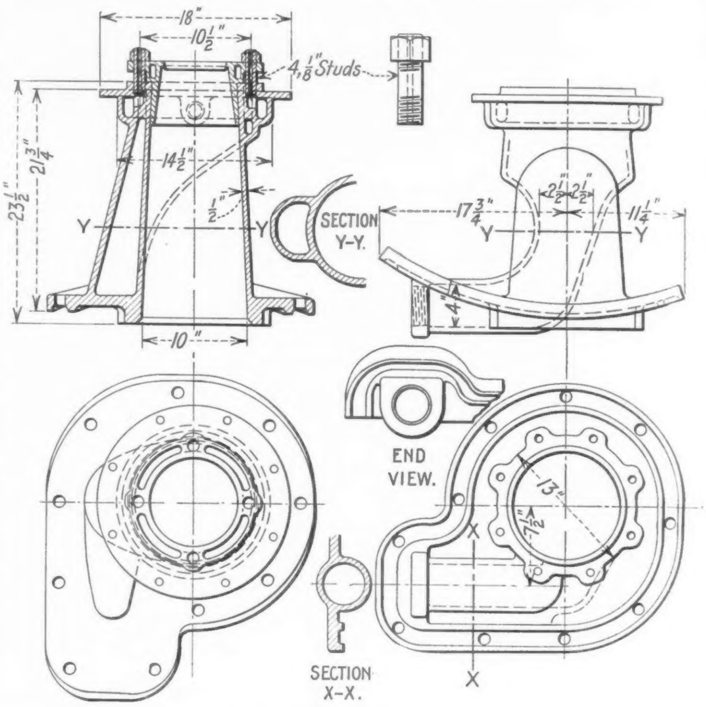
The high-pressure exhaust, when operating simple, is carried from the intercepting valve through a 3½-in. pipe to an opening in the base of the exhaust nozzle casting outside the smokebox. This opening leads to an annular chamber outside the main exhaust passage and discharges through annular openings in the top of the casting. The high-pressure steam connection is a 3½-in. pipe which leads directly into the main steam passage at the top of the steam chest of high-pressure cylinder casting. The location of the intercepting valve in direct connection with the high pressure cylinder not only makes it readily accessible for repair or adjustment, but shortens such pipe connections as are required.

Among the other special features, which may be mentioned in the equipment on this locomotive, is the use of the Owen's system of force feed lubrication, with oil inlets at the bottom of both cylinders as well as in both valve chests. The boiler tubes are fitted with Coleman safe-ends, one of which is illustrated.

The tender, which has a capacity of 9,000 gal. of water and 15¼ tons of coal, is carried on a Franklin tender truck at the front end and an M. & L. tender booster truck.

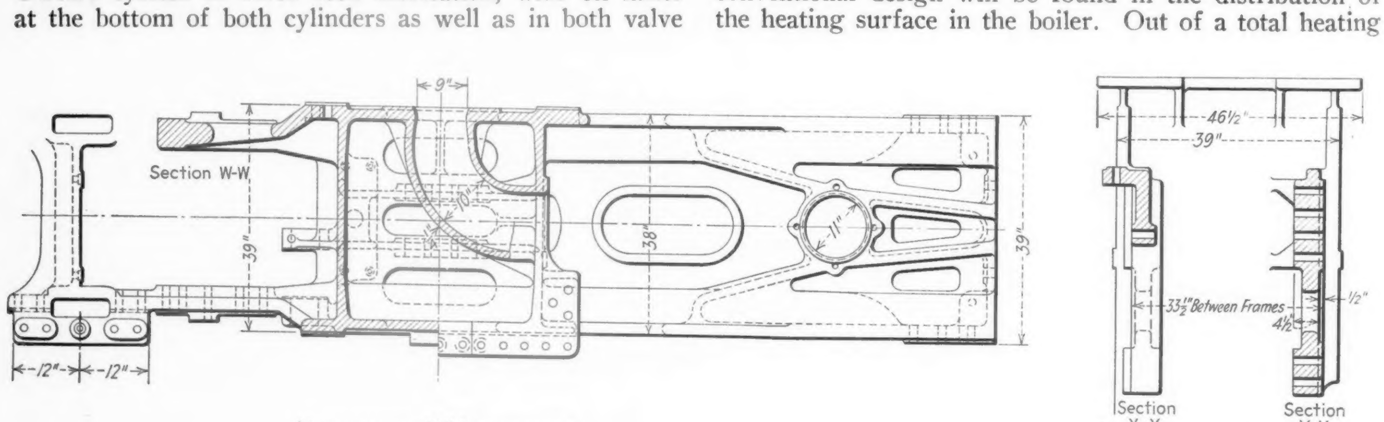
What is expected of the "Horatio Allen"

Probably the outstanding difference in the proportions of the "Horatio Allen" as compared with locomotives of



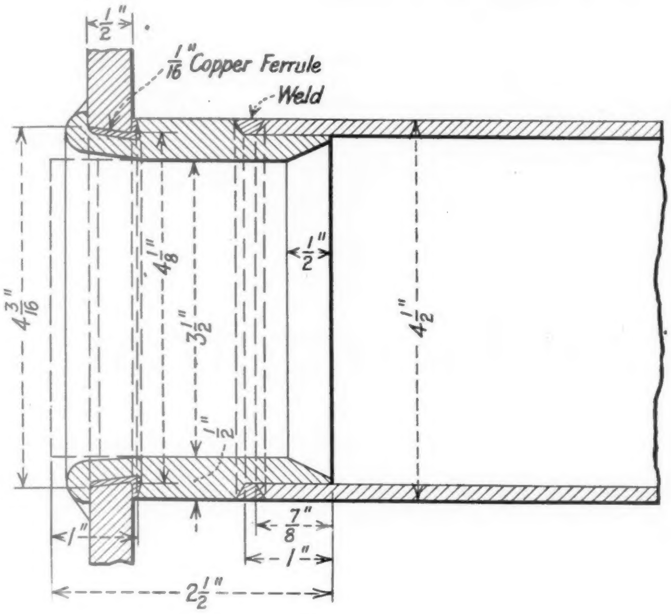
The exhaust nozzle

conventional design will be found in the distribution of the heating surface in the boiler. Out of a total heating surface of 3,200 sq. ft., 1,187 sq. ft., or 37 per cent, is located in the firebox. This is the result of the water-tube



The steel front frame and saddle support casting

construction. Considering the much greater evaporative value of the firebox heating surface as compared with that of the fire tubes, the capacity of the boiler is much greater than indicated by the total heating surface when compared with the same total amount in a boiler of conventional design, where probably less than 10 per cent of the total would be contained in the firebox. Another factor of in-



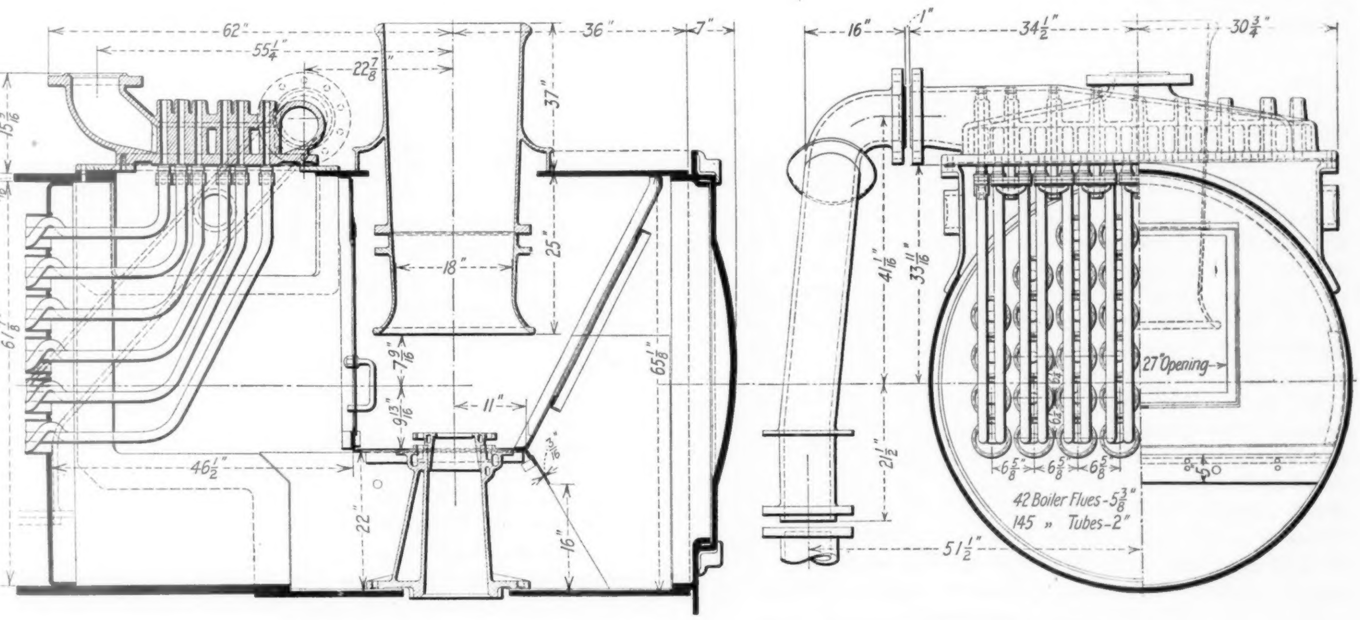
The Coleman safe end as applied to the superheater flues

terest is the comparatively small amount of superheating surface, the total of which is 579 sq. ft. The purpose in this case, however, was to limit the maximum steam tem-

350 lb., however, the saturated steam temperature is raised to approximately 436 deg. and the amount of heat which can be imparted to the steam within a limit of 620 deg. is correspondingly reduced. Until it is determined what effect will be produced by a combination of high pressures and high temperatures, it was considered safer not to exceed the above maximum temperature.

The main purpose throughout the design of this locomotive has been to make available the increase in economy and capacity provided by the greater expansion range of pressures considerably higher than those commonly employed. Considering the latent heat of evaporation as a fixed charge which must be distributed over the additional heat applied to build up the pressure to its working point, it is evident that considerable thermal advantage is to be gained by increasing the working pressure and thus decreasing the amount of latent heat which must be charged against each pound of useful pressure. The total heat in one pound weight of steam at 200 lb. pressure, is 1,199 B.t.u., but 1,150 B.t.u. remain in the steam after it has expanded down to atmospheric pressure, a difference of 49 heat units per pound. To raise the steam from 200 to 350 lb. requires a fraction over 7 additional heat units while the expansion range has been increased 75 per cent.

The calculated improvements in economy, which are expected from this design, are 15 per cent less fuel per drawbar horsepower-hour from the increase in pressure; a reduction of 12 per cent in fuel per drawbar horsepower-hour attributable to the boiler, because of the generation of 75 per cent instead of 40 per cent of the steam in the firebox, and the improved circulation in the water-tube type of construction and a reduction of 17 per cent in fuel by compound expansion in the cylinders. This amounts to a combined estimated saving of approximately 39 per cent in the fuel consumption per drawbar horsepower-hour.



The front end arrangement, showing the outside superheater header

perature to approximately 600 to 620 deg. F. and this temperature became the controlling factor in the design rather than the amount of superheat. With a boiler pressure of 200 lb. per sq. in., the superheater starts to build up the temperature of the steam from a saturated temperature of 388 deg. F. With the pressure increased to

The principal dimensions and proportions are as follows:

Table of dimensions, weights and proportions

Builder	American Locomotive Co.
Railroad	Delaware & Hudson
Type of locomotive	2-8-0
Service	Freight

Cylinders, diameter and stroke	23½ in. by 41 in. by 30 in.
Valve gear, type	Young
Valves, piston type, size	H.P., 12 in.; L.P., 14 in.
Maximum travel	9 in.
Weights in working order:	
On drivers	298,500 lb.
On front truck	49,500 lb.
Total engine	348,000 lb.
Tender	197,800 lb.
Wheel bases:	
Driving	18 ft.
Rigid	18 ft.
Total engine	29 ft.
Total engine and tender	65 ft., 7¾ in.
Wheels, diameter outside tires:	
Driving	57 in.
Front truck	36 in.
Journals, diameter and length:	
Driving, main	12 in. by 14 in.
Driving, others	11 in. by 14 in.
Front truck	7 in. by 15 in.
Boiler:	
Type	Combined water and fire tube
Steam pressure	350 lb.
Fuel, kind	Bituminous and anthracite mixed
Diameter, first ring, inside	61⅞ in.
Firebox, length and width	137 in. by 74⅝ in.
Arch tubes, number and diameter	6—3½ in.
Fire tubes, number and diameter	145—2 in.
Fire flues, number and diameter	42—5⅜ in.
Length over tube sheets	15 ft.
Grate area	71.4 sq. ft.
Heating surfaces:	
Firebox	1,124 sq. ft.
Arch tubes	63 sq. ft.
Tubes	1,132 sq. ft.
Flues	881 sq. ft.
Total evaporative	3,200 sq. ft.
Superheating	579 sq. ft.
Comb. evaporative and superheating	3,779 sq. ft.
Tender:	
Water capacity	9,000 gals.
Fuel capacity	15¼ tons
General data estimated:	
Rated tractive force, simple	84,300 lb.
Rated tractive force, compound	70,300 lb.
Booster	19,700 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	86
Weight on drivers ÷ tractive force, simple	3.54
Weight on drivers ÷ tractive force, compound	4.24

Design of the steam locomotive

Discussion of three-cylinder advantages—Vital importance of proper design as a maintenance factor

By J. G. Blunt

Mechanical engineer, American Locomotive Company

As we approach the end of the first hundred years of locomotive service and reflect on the increasing benefits which the reciprocating steam locomotive has given to the transportation problems of today, we are mindful of the seventy-five or more experimental years which preceded it in the making of that historic event. Surely that occasion will, in due time, be celebrated as a reminder of the principles developed during those experimental years, which are the basic ones involved in our locomotive construction today.

In those early years, the problem required a locomotive having the greatest starting power, with means for exerting the maximum tractive force gradually throughout its speed range. The problem today is likewise to produce an individual power unit, possessing this fundamental principle and capable of exerting its full tractive force per unit of weight on each driving axle, while attaining speeds within the limit of safety to human life, the locomotive mechanism and to the right-of-way generally, requiring a minimum of maintenance, with the most economical use of fuel per ton mile hauled.

We have today various means of locomotive power transmission other than the reciprocating steam locomotive, such as electric locomotives using various mechanical and electrical means of transmitting power to the driving wheels, the steam turbine, and various forms of internal combustion engines using gasoline or crude oil which are receiving marked attention, both here and abroad, as sources of locomotive power. Transmitting power from a constant speed motor to the driving wheels, requiring a speed range from nothing to maximum, offers difficult mechanical problems or involves large expenditure in the utilization of electrical transmission.

Various speakers have predicted a decline in the ability and efficiency of the reciprocating steam locomotive to meet the major transportation problems of the future. While these predictions may eventually be confirmed, the fact remains that no locomotive power unit has been produced on a commercially economic basis to cope with the reciprocating steam locomotive in cost of operation per ton mile under average conditions in long distance heavy duty transportation. It, therefore, remains an economic necessity to make the steam locomotive as efficient a power unit as possible until those predictions have reached a degree of commercial utility warranting their general substitution in place of the reciprocating steam locomotive. Many noteworthy efforts have been made, or are now undergoing experimental development, possessing great potential value.

With the foregoing assumption, the problem now is to select that application of the reciprocating principle for the larger steam locomotive units most nearly approaching these commercial requirements and one which will, under varying conditions, deliver the maximum power, speed and economy, at the same time requiring the operation of the fewest number of units to handle the traffic, while transporting the maximum possible trainload over an existing railway line.

The advantages of the three-cylinder type

Thorough investigation has convinced many that the single expansion, three-cylinder application most fully meets these commercial requirements at this time, although future improvements will undoubtedly follow its more or less general use. Efforts, in other ways, are being made and much has been accomplished to utilize higher boiler pressures, devices to provide auxiliary power and great fuel economy, as well as better means for handling the larger power units with greater ease and safety. It readily lends itself to the usual wheel arrangements, with a minimum complication in return for the power produced per locomotive unit having a given driving axle load.

Undoubtedly the most efficient wheel arrangement obtains when connecting the middle cylinder to the crank axle and the outside cylinders to an adjacent axle, thus more evenly distributing the cylinder power throughout the mechanism,

*A paper presented at a meeting of the St. Louis Railway Club, November 14, 1924.

with the least tendency toward slipping or dynamic effect.

In comparing two locomotives with the same wheel arrangement, one having two cylinders and the other three, and assuming equal boiler pressures and driving axle loads, the normal tractive force can be materially improved without increasing the slipping tendency, at the same time increasing the starting power by double the normal tractive force increase. Tests have shown a substantial fuel saving per ton mile hauled, with speed increases, following the better distribution of forces within the mechanism, in combination with the lesser dynamic effects to the rail and roadbed.

In considering locomotives of the sizes required on our trunk lines at this time, no application offers as many practical advantages throughout the speed range as a locomotive equipped with the three-cylinder principle.

It straightens out the tractive force fluctuations for each driving wheel revolution, delivers more tractive force per pound of weight involved and reduces the dynamic effects on the rail. It provides more even power distribution to the mechanical parts, with correspondingly reduced stresses in the locomotive mechanism and right-of-way construction. It eliminates the nosing effects of the inside cylinder entirely, while materially reducing this effect in the outer cylinders by reason of their smaller diameter. It requires less truck lateral resistance, with correspondingly less wear from hub and flange pressure. It enables the steam in the cylinders to be used more expansively through a larger percentage of its running time, while having greater starting ability, accompanied by a substantial fuel saving for tonnage hauled. There is less danger of frame failure on account of the smaller outside cylinders, with less overhanging pressure acting through the rods and axles on the frames. The six exhausts per driving wheel revolution produce a more even draft on the fire, enabling the use of larger exhaust nozzles, with less back pressure in the cylinders, resulting in still greater fuel economy.

Some factors in design

To function best throughout the speed range, a road locomotive should have a leading and a trailing truck to guide it around curves and absorb the lateral vibrations while sliding the driving wheels across the rail when changing the direction of motion from a tangent line through curves, and to absorb the vibration set up by the unbalanced reciprocating forces, as well as those brought about by track irregularities.

The lateral resistance in either truck acts as a long lever arm, extending from the center of one to the center of the other, in absorbing these forces, providing their lateral resistances are operative immediately when moving from their central position and in proportion to the length of wheel base and speed requirements of the locomotive. Under these conditions, the lateral resistance requirement becomes a minimum. With these provisions, hub friction and flange wear are likewise reduced and the frames, frame structure and boiler attachments are subjected to the least detrimental forces.

The spring suspension also has an important bearing on the riding qualities of the locomotive, which becomes increasingly more important in absorbing the rolling tendency as the speed increases. It is fundamental that the load resting thereon should be carried on three independent bearing points, having no connecting equalizations tending to lessen the vertical stability or disturb the even setting of springs and equalizers so linked up. Unmechanical means for correcting or maintaining this stability tend to disturb the individual axle loading.

The relation of design to maintenance

The annual maintenance costs for each freight and passenger locomotive, according to I. C. C. reports for the last four years run around $10,000.* Many causes contribute to these outlays, but I shall discuss them primarily from the viewpoint of the builder.

While operating over irregular track and around curves, the locomotive mechanism is subjected to many complex movements. Where possible of analysis, provision must be made in the design, such that every movement involved is amply provided for in a manner to avoid unknown and incalculable stresses and to relieve bearing surfaces from imperfect surface contact. Failure to provide for them involves excessive wear or fracture and the addition of useless weight. They become, therefore, a fruitful source of increased maintenance. These correct movements must be obtained, however, with a minimum of complication else the cure will be more expensive than the cause. If they are well done, the mechanical efficiency will be increased, along with the mileage, and maintenance costs decreased throughout the life of the locomotive.

Main connecting rods are illustrative of this condition, connected as they are at one end to parts above and oscillating over the spring rigging, while the other is connected to parts below the springs. A degree of universal movement is required in one end relatively to the other, in order that these bearing surfaces may rest uniformly on their respective pins while assuming varying angular positions, which become increasingly more severe as the rod angularity, speed and rolling of the locomotive increase. The angular positions of the rod, together with the maximum angular variations of the axle or pin, unnaturally stress the rods and twist the bearings on their pins, resulting often in heated journals, wasted lubricant, pounding, broken brasses, broken or dislocated rod parts, or failure at the weakest point subject to these unknown stresses. A rolling engine and an uneven track simultaneously centralize unknown stresses in the rods or their connecting parts, the weakest point of which often gives trouble. This involves expensive maintenance which can be corrected only by the use of mechanical construction fully responsive to these movements. Floating bushings have given much relief. Rods constructed as a universal joint offer a naturally correct means for the relief of these abnormal stresses.

Side rod and driving box design

Means to partially relieve coupling rod troubles have been found in the use of floating bushings, while the use of rotative bearings on all but the main connection offers still further relief in providing for the varying angularities of axles, thus eliminating some of the contributing causes for the unknown stresses to which side rods are subjected. These conditions become more pronounced as the size of bearings increases. Surely an automobile or truck would not remain long in service if its power were transmitted in a similar manner.

Driving boxes should undoubtedly be provided with means to prevent the sides from closing in on the journal, due to the reciprocating action of the rods. Supplemental bearings, fitting the axle for a distance below its horizontal center, offer means to minimize the accumulation of longitudinal play in the driving journals, giving substantial relief from the pounding effects in the boxes, which are in turn transmitted to the coupling rods. It may be practical to apply driving box brasses with slight pressure in the box casting if suitably designed, as many are found loose when locomotives come in for repairs. Such an application would relieve the box casting of distortion from the high pressures used when forcing in the journal brasses.

All main journal bearings for engine truck, drivers and trailer, as well as tender, should be provided with means to oil, pack or regrease through non-detachable spring lid covered openings, having means for supplying as free a flow

*See Railway Age for September 9, 1924, page 531.

of clean lubricant to hub surfaces and oil bearing surfaces as possible and well protected from contact with dirt and cinders. Generally speaking, the aim in design should be to require the fewest number of points to lubricate, each of which will supply the need for the greatest length of time and be in the most accessible location. Hub liners securely fastened, easily removable and replacable without dropping wheels may be used to simplify maintenance.

Provision for easy removal and inspection of drawbar pins between engine and tender at engine end, when stoker applications prevent lifting them from above and the booster prevents removing them from below, has been frequently suggested by railway men. Devices using horizontally removable pins have been applied, using double bars equalizing through a circular disc at the tender end. These double bars increase the safety factor between engine and tender and in case one bar or pin fails, the other provides the safety feature while making constant use of both.

The boiler, aside from its pressure stresses and those due to heat expansion, forms the backbone of the locomotive, maintaining the mechanism in alinement. A previous paragraph explains how stresses in the frame fastenings are relieved by absorbing the causes of vibration in the truck resistance mechanism before those stresses reach the frame. The whole frame structure and its attachments to the boiler are thus relieved. If frame attachments to the boiler give trouble, attention should be directed to the truck resistances, because one of the main functions of leading and trailing trucks is to guide the engine and absorb the vibratory actions so destructive at these points.

One of the most destructive forces set up in the locomotive is caused by unrelieved water in the cylinders. Application of effective means to prevent such pressures from exceeding, say 50 lb. above boiler pressure, would assist in preventing the fracture of cylinder heads, forcing the piston or crosshead on the piston rod, carrying the end of the cylinder away or loosening its frame fastenings. Evidently these unrelieved pressures, which at times are destructive, contribute to broken piston rods, connecting rods, axles, frames and other parts subjected thereto, which would largely disappear with the removal or partial removal of the cause. Working steam pressures are the least contributing cause of such trouble.

Center pin bolster bearing trucks, whether of the two-wheel radial or four-wheel center bearing type, should provide for lateral motion devices whose bearing surfaces maintain constant alinement with the axle throughout their range of lateral movement. Otherwise, twisting on the bearing surfaces of these mechanisms, or binding on their bearing surfaces, provide another expensive maintenance cause.

This provision is simply made in the four-wheel center bearing truck by machining the guiding surfaces of the bolster and bolster guide, and in the two-wheel trucks by providing means to maintain the alinement of its top and bottom surfaces relatively to each other throughout their range of lateral movement.

Improved design and construction throughout the locomotive to meet the conditions described, will, in some cases, involve additional first cost, although ingenuity and originality will as often eliminate it. Mindful, however, that destructive causes following incorrect construction are a fruitful source for maintenance expense, some additional outlay at the start would seem well worth while, and I believe the time is coming when the locomotive mechanism will be perfected so as to respond fully to every involved movement capable of analysis. This should always be the objective, for with it go longer individual runs, increased mileage between shoppings, decreased maintenance costs and fewer locomotives to move a given tonnage.

Discussion of locomotive steels*

Heavy modern power requires a better grade of steel—Proper heat treatment essential when repairing alloy steel parts

By Lawford H. Fry

If the time were not limited it would be interesting to cover the subject fully, following the processes of manufacture from the ore to the locomotive builder's shop. However, we can only touch briefly on the important points. Examination of the various steels entering into locomotive construction shows that they range in composition from one per cent carbon of the springs to less than two-tenths of one per cent of carbon in boiler and structural steels, with several alloy steels included in the forging grades. Recent developments make this group the most interesting to steel treaters.

In order to present the subject logically, let us first analyze the structure of a locomotive. Take as an example the heavy Decapod freight locomotive of the Pennsylvania System. Examination shows that it is made up of three structural units—

(A) The boiler.
(B) The chassis, made up of frames, axles, wheels and springs.
(C) The engines which rotate the wheels.

Let us further dissect these units to ascertain what steels enter into their composition—

(A) The boiler, though large and important, is comparatively simple so far as steel is concerned. The sheets of the barrel and of the inside firebox are of low carbon low tensile steel, the flues and superheater pipes are of similar material, though in some cases charcoal iron flues are used.

(B) The chassis contains a more varied collection of steels; the principal parts classified by the carbon content of the steels used are as follows:
- (a) Carbon about 1.0 per cent, springs.
- (b) Carbon about .75 per cent, tires and rolled steel wheels.
- (c) Carbon about .50 per cent, forgings, such as rods, axles, crank pins, etc.
- (d) Carbon about .25 per cent, castings, such as frames, crossties, driving wheel centers, etc.

(C) The engine adds little to the preceding list of steels, as outside of the cast iron cylinders with which we are not concerned, they are built of forgings and castings similar in composition to those in the chassis.

We are now in a position to group the various steels together and to consider them more in detail. In order to give background to this consideration I offer for comparison one of the first Pennsylvania Consolidation locomotives. The Consolidation locomotive thirty years ago was, as is the Decapod locomotive today, the heaviest standard freight locomotive on the Pennsylvania System. The old Consolidation engine weighed in working order about 126,000 lb., while the modern Decapod locomotive weighs about 386,000 lb. The weight has tripled in thirty years. This great increase in size has brought new problems to the locomotive designer, to the steel

*A paper presented to the New York Chapter of the American Society for Steel Treating, December 17, 1924.

maker and to the steel treater. Formerly it was sufficient for a draftsman to write *steel* on his drawing of a forging, and no one would raise any question as to specification or heat treatment. Today the designer must choose between a variety of steels and many heat treatments, and his choice must be determined not only by the properties of the steel as it appears in the finished part, but also by the behavior of the steel during the life of the locomotive, by the treatment it must receive during repairs, and by the facilities for such treatment which are available in the railroad repair shops. We shall see this in greater detail in considering the various steels.

Boiler steels

The boiler of the Decapod locomotive weighs without flues about 58,000 lb., and about half as much again with flues and superheater. The largest plate measures 269 in. by 90 in. by 1⅛ in. and weighs 8,550 lb. In the boiler of thirty years ago the largest plate measured 191 in. by 83 in. by 7/16 in. and weighed 1,970 lb. The increase is 60 per cent in area and nearly 200 per cent in weight. So far as material is concerned there has been little change. Boiler plate, then as now, was bought to a specification requiring a tensile strength of 55,000 to 65,000 lb. per sq. in. with approximate ductility requirements. Bend tests are required and nick-and-break tests for homogeneity are now made on firebox plates and on others requiring special flanging. The quality appears to be stabilized and no developments are anticipated in the near future.

Steel castings

The frames are the largest single castings, weighing about 22,000 lb. each and measuring nearly 45 ft. in length. The driving wheel centers account for about another 30,000 lb. and the crossties, frame braces, foot plates, etc., about as much again, say, in round figures, 50 tons of steel castings. This represents a branch of the steel industry which has practically come into existence in the last thirty years and is still developing. Thirty years ago locomotive frames were of wrought iron, driving wheel centers of cast iron and crossties were built up from shapes. The majority of steel castings now used in locomotive work are furnished to a minimum tensile strength of 70,000 lb. per sq. in., but conditions have by no means crystallized. Special designs and special steels are being tried out. There has been a tendency to combine more and more parts into a single casting. Starting with the trailing truck frame and tender truck and tender frames cast in one piece, unification has developed to the point of making a single casting to replace the two locomotive frames and their crossties. This bold experiment is still in the making, but it represents a continuation of development along lines which have already proven satisfactory.

Springs

There has been little development in thirty years, except in size. At present, attention is being given to the question of improvement in springs. To carry out such improvements exact data as to the service being given by locomotive springs are required. If this is accumulated by the railroads and better springs are demanded, steel makers and steel treaters will respond. The large majority of locomotive springs are made of a plain carbon steel having about one per cent of carbon and low silicon and manganese. The steel is quenched from the fitting temperature and removed from the oil which is still so warm that a separate draw is not required. Some railroads are using a steel with from .25 to .50 per cent silicon and a few of the more progressive roads are looking to the use of modern accurate methods of heat treatment.

Tires and rolled steel wheels

The use of rolled steel wheels for engine trucks is a growth of the last twenty years. The steel is of the same general composition as is used for tires with carbon from .60 to .85 per cent. For tires the carbon runs from .55 to .70 per cent for passenger, .60 to .80 per cent for freight, and .70 to .85 per cent for switching service. These are the steels which have been used with practically no change for the last thirty years. Further, there has been no change in tire dimensions. This is the one steel part of a locomotive which shows no change in dimensions or material. Nor is any to be expected. There is little indication of any change being made in the grade of steel used, and there is no possibility of increasing the tire section. This is fixed by well established clearances and rail designs. While locomotive weights have increased three times and the wheel loads two and one half times the tires carrying these loads have remained unchanged. As a consequence, if the tires are to carry the increased loads satisfactorily, great vigilance must be used in maintenance. Shimming should be avoided wherever possible, and when unavoidable new steel of known and uniform thickness should be used. Shims should be applied in as few pieces as possible without overlaps and without gaps. Tires should not be removed from wheel centers for turning. The heavy modern wheel loads cause a certain amount of distortion of tire and wheel center so that the removal of a tire and reapplication in a different position leave part of the tire unsupported. Further distortion follows naturally, and failure may result.

Forgings

As has already been pointed out, we find here a greater variety of steels and of heat treatments than in any of the other steel parts. Let us first dispose of the smaller forgings such as valve motion parts. As it is desirable to have lighter moving parts, some railroads have taken advantage of specially made and treated steels. Good results can be obtained thus, but such parts must not be heated in repairing. Eccentric rods which may require heating for setting to length in construction or repair should be of a comparatively low carbon, say not over .40 per cent without alloys.

For the main locomotive forgings such as driving axles, main and side rods, and crank pins, the following steels will be found in current use:

Plain carbon steel.
  Carbon about .45 to .50 per cent. Such steel is to be used annealed or quenched and tempered, or even, in the case of parts made in railroad shop, unannealed.
Chrome nickel steel.
  Quenched and tempered.
Chrome vanadium steel.
  Quenched and tempered.
Carbon vanadium.
  Steel normalized.

Of these the quenched and tempered alloy steels with an elastic limit of 65,000 lb. per sq. in. and a tensile strength of 110,000 to 125,000 lb. per sq. in. give the greatest strength per unit of weight. They have the disadvantages of high first cost, difficulty in machining, and the necessity for care in maintenance to avoid heating which would remove the desirable properties given by the original heat treatment.

Standing next in point of strength is the normalized carbon vanadium steel with a yield point of 62,000 lb. per sq. in. and a tensile strength of about 100,000 lb. per sq. in. This steel owes its strength to a manganese content of about .90 per cent, the vanadium serving to ensure ductility on normalizing. The heat treatment usually consists in heating to about 1,600 deg. F. and cooling in air

(normalizing) followed by a reheating to about 1,150 deg. F. This steel compared with the quenched and tempered steels has the advantage of not having been subjected to the severe internal strain of quenching, and also does not lose so much of its strength on being reheated in repairs.

Quenched and tempered carbon steel with an elastic limit of 50,000 to 55,000 lb. per sq. in. and a tensile strength of about 90,000 lb. per sq. in. stands close to carbon vanadium steel in strength. It loses more of its strength on being reheated.

In using the quenched or tempered steels or normalized carbon vanadium steel for round forgings, such as axles or crank pins, it is of great advantage to bore a hole of ample diameter along the longitudinal axis. It is recommended that the diameter of the hole be approximately half the outside diameter of the forging. This has the advantage of reducing the thickness of metal through which heat must penetrate during treatment. In a bored forging, heating and cooling take place in the bore as well as from the outside, and in the case of quenched forgings this is of great importance in reducing the internal strains set up during quenching. Large forgings when bored respond more readily to heat treatment and better physical properties can be obtained. Even apart from this, boring is advantageous in giving greater strength per unit of weight. With two forgings of the same material and of the same weight the bored forging can be made about fifteen per cent stronger than the solid.

Last but not least come the annealed firebox steel forgings. These make up the majority of locomotive forgings. Annealed carbon steel is simple to make and simple to handle, and is to be preferred except under special conditions in which higher tensile strength is necessary. Though the annealed plain carbon steel forgings are the simplest to make, it must be remembered that with these as with all other forgings it is essential to have sound well-made steel to start with if satisfactory results are to be secured. Also correct and accurate control of annealing temperatures is desirable.

Locomotive and motor car orders in 1924

A number of developments of previous years have progressed sufficiently to be incorporated into new power

A TOTAL of 1,413 locomotives were ordered for domestic service in the United States during 1924. This total compared with 1,944 in 1923, and with 2,600 in 1922, and represents an amount of business much below the average. Since 1901 there have been but four years, other than 1924, in which domestic locomotive purchases have failed to exceed even such a small total as 1,500.

The information given in Table I shows that the orders placed by railroads in Canada with Canadian builders totaled 71, comparing with 82 in 1923, and with 68 in 1922. The National Railways of Mexico were heavy purchasers of equipment in United States markets; their buying included 50 locomotives, as well as large numbers of cars. Other export business, outside of the Mexican purchases, totaled 92 locomotives.

Table I—Orders for locomotives since 1915

Year	Domestic	Canadian	Export	Total
1915	1,612	....	850	2,462
1916	2,910	....	2,983	5,893
1917	2,704	....	3,438	6,142
1918	2,593	209	2,086	4,888
1919	214	58	939	1,170
1920	1,998	189	718	2,905
1921	239	35	546	820
1922	2,600	68	131	2,799
1923	1,944	82	116	2,142
1924	1,413	71	142	1,626

The number of locomotives built for domestic service—in contradistinction to new business taken as shown in the totals for orders—was 1,726. This compared with 3,362 in 1923, and, as in the case with orders, was considerably below average.

The Car Service Division reports each month the number of locomotives installed and retired on the Class I roads. For the year 1923 these reports showed that there were installed 4,037 locomotives, and that there were retired 3,672. The latest report from 1924 to date is that for November. In the first eleven months of 1924, installations totaled 1,951—indicating a figure for the year less than half the total for 1923—while retirements for the eleven months totaled 1,844.

In no month during the past year was locomotive buying particularly heavy. The best month of the year was March, in which month orders for 283 locomotives were reported, and the next best was October, in which month orders totaled 135. Orders in June totaled one only, and in August only eight.

Table II—Important locomotive orders in 1924

	0-6-0	0-8-2	2-8-0	2-8-2	2-10-2	Mallet	4-6-0	4-6-2	4-8-2	4-10-2
A. T. & S. F.	..	..	..	26	15	..	..	10	6	..
A. C. L.	5	..	..	..	..	..	..	20	..	..
B. & A.	4	..	..	..	..	..	..	5	..	..
Can. Nat.	..	..	..	30	5	..	..	..	21	..
Can. Pac.	..	..	..	15	..	..	..	..	..	..
C. of Ga.	..	..	..	10	..	..	..	..	..	..
C. of N. J.	..	..	..	20	..	..	..	..	..	..
C. & O.	..	..	..	100	..	..	..	..	..	..
C. R. I. & P.	..	..	..	..	..	..	..	1	10	..
C. C. C. & St. L.	20	..	..	25	..	..	..	5	..	..
Fla. E. C.	11	..	..	..	..	..	..	..	32	..
G. T. (in U. S.)	15	..	..	..	..	..	..	..	..	..
I. C.	..	..	..	25	..	..	..	..	25	..
I. H. B.	..	5	..	5	..	..	..	..	..	..
L. A. & S. L.	..	..	..	..	10	..	..	..	5	..
L. & N.	14	..	..	34	..	..	..	6	..	..
Me. C.	..	..	..	6	..	..	..	2	..	..
M. C.	10	..	..	15	..	..	..	5	..	..
M. K. T.	10	..	..	..	..	..	..	..	..	..
M. P.	20	..	..	60	..	..	..	20	..	..
Nat. Rys. of Mex.	..	..	25	10	..	..	10	4	..	..
N. Y. C.	50	..	..	50	..	..	..	..	..	..
N. Y. C. & St. L.	10	..	..	10	..	..	..	..	..	..
N. Y. N. H. & H.	10	..	..	..	..	..	..	..	..	..
Pennsylvania	50	..	..	..	..	..	50	50	..	..
P. & L. E.	..	..	..	11	..	..	..	..	..	..
P. & R.	5	..	25	..	..	..	..	10	..	..
S. A. L.	..	..	..	30	..	..	..	..	..	..
So.	30	..	..	25	..	5	..	15	..	..
S. P.	..	..	..	..	1	..	..	..	..	16
Term. R. R. of St. L.	15	..	..	..	..	..	..	..	..	..
U. P.	..	..	..	..	..	20	..	..	..	..
Wabash	1	..	..	50	..	..	..	..	..	..
W. P.	..	..	..	5	..	5	..	..	..	..

The railways handled in October the largest amount of

business, gaged by net ton-miles, that they ever handled in a similar period of time. On December 1 there were on hand 4,904 locomotives stored in serviceable condition, thereby indicating the results of the buying program of 1922, followed by the ambitious repair program of 1923, as well as the results of better locomotive utilization. This may be the explanation of the failure of locomotive purchases in 1924 to be commensurate with the volume of other railway purchases. Possibly the balance will be restored in 1925, and resort had to purchases of new power needed now less to increase merely the total amount of tractive effort, but desired rather because of the possibility of securing more effective motive power units in place of much of the older and less efficient power still remaining in service.

Table III—Types of locomotives ordered in 1924

Type	Railroad	Industrial	Export	Total
0-4-0	0	3	0	3
0-6-0	13	34	4	51
0-6-2	2	0	0	2
0-8-0	295	2	0	297
0-8-2	5	0	0	5
0-10-0	1	0	0	1
2-6-0	3	4	11	18
2-6-2	5	10	0	15
2-8-0	61	1	4	66
2-8-2	582	12	50	644
2-10-0	3	0	0	3
2-10-2	31	0	1	32
Mallet	34	4	1	39
4-4-0	7	0	0	7
4-6-0	69	0	0	69
4-6-2	167	0	4	171
4-8-0	3	0	0	3
4-8-2	113	0	4	117
4-10-2	16	0	0	16
Miscellaneous	0	6	2	8
Geared	0	16	1	17
Forney	1	3	0	4
Shay	1	3	0	4
Electric	24	0	10	34
Total	1,436	98	92	1,626

Table IV—Three-cylinder locomotives ordered in 1924

Road	No.	Weight Lb.	Cylinders, in.	Type	Service
Chicago, Rock Is. & Pacific	1	305,000	22½ x 28	4-6-2	Pass.
Delaware, Lacka. & Western	2	392,000	25 x 28	4-8-2	Pass.
Lehigh Valley	6	369,000	25 x 28	4-8-2	Frt. & Pass.
Louisville & Nashville	1	334,000	23 x 28 & 32	2-8-2	Frt.
Missouri Pacific	1	302,500	22½ x 28	4-6-2	Pass.
Missouri Pacific	1	334,000	23 x 28 & 32	2-8-2	Frt.
N. Y., N. H. & Hartford	10	245,000	22 x 28	0-8-0	Sw.
Southern Pacific	16	438,000	25 x 28 & 32	4-10-2	———
Wabash	5	351,000	23 x 28 & 32	2-8-2	Frt.

During the year which has just closed, the total capital expenditures authorized by the Class I railroads of the United States amounted to $1,077,297,000. Of this amount $101,233,000, or 9.4 per cent of the total authorized expenditures, was for locomotives. In 1923, 19.75 per cent of the total expenditures were for locomotives.

Types of locomotives ordered

A summary of the more important orders, grouped according to roads and types, placed in 1924, will be found in Table II. This list includes 1,286 locomotives for 34 railroads or 79 per cent of the locomotives ordered by the American, Canadian and Mexican roads. The balance was in small orders from a number of railroads.

Table III shows the types of locomotives which were ordered for the railroads, industrial concerns and for export. Similar information for the preceding year will be found on page 77 of the February, 1924, issue of the *Railway Mechanical Engineer.*

It will be observed that of the 1,436 locomotives ordered by the railroads in 1924, 316 or 21 per cent were for switching service. The preponderance of the orders were for the 0-8-0 type, for which there were 295. The largest orders for switch engines were those placed by the New York Central and the Pennsylvania for 50 each of the 0-8-0 type. An interesting phase of last year's purchasing was the comparatively few orders placed for the 0-6-0 type.

Locomotives with two-wheel leading and three, four or five pairs of drivers, totaled 685 or 47.7 per cent of the railroad orders. In this group, 582, or 40.5 per cent, were of the 2-8-2 type. Roads which placed orders for at least 25 locomotives of the 2-8-2 type were the Atchison, Topeka & Santa Fe; Canadian National; Chesapeake & Ohio; Cleveland, Cincinnati, Chicago & St. Louis; Illinois Central; Louisville & Nashville; Missouri Pacific; National Railways of Mexico; New York Central; Seaboard Air Line; Southern and the Wabash. Of the 61 orders for the 2-8-0 type 25 were for the Philadelphia & Reading and 25 were for the National Railways of Mexico. It will be recalled that the Philadelphia & Reading ordered 25 of the same type in 1923. Orders for the 2-10-2 include 15 for the Atchison, Topeka & Santa Fe and 10 for the Los Angeles & Salt Lake.

There were 34 Mallet locomotives ordered in 1924 or 19 less than the number ordered in 1923. The largest order placed for this type in 1924 was 20 for the U. P.

A total of 405 locomotives of the type usually employed in express and passenger service were ordered last year; this was 20.8 per cent of the total of all orders. Of these, 167 were of the 4-6-2 type, 113 were of the 4-8-2 type and 69 were of the 4-6-0 type. The largest order for the 4-6-2 type was for 50 placed by the Pennsylvania, which also ordered 50 of the 4-6-0 type. Orders for 20 of the 4-6-2 type were placed by the Atlantic Coast Line and the Missouri Pacific.

Table V—Principal orders for 2-8-2 locomotives in 1924

Road	No.	Weight, lb.	Cylinders, in
Chesapeake & Ohio	50	358,000	28 x 30
Atchison, Topeka & Santa Fe	26	343,200	27 x 32
New York Central	50	337,000	28 x 30
Pittsburgh & Lake Erie	11	337,000	28 x 30
Michigan Central	15	334,500	28 x 30
Cleveland, Cincinnati, Chicago & St. L.	25	334,500	28 x 30
Louisville & Nashville	1	334,000	23 x 28 & 32*
Missouri Pacific	1	334,000	23 x 28 & 32*
Wabash	20	329,000	27 x 32
Southern	25	326,000	27 x 32
Canadian National	20	324,600	27 x 30
Canadian Pacific	15	321,400	25½ x 32
Seaboard Air Line	10	320,900	27 x 28
Louisville & Nashville	17	320,000	27 x 32
New York, Chicago & St. Louis	10	317,500	26 x 30
Central of Georgia	10	300,500	27 x 30
Illinois Central	25	300,500	27 x 30
National Railways of Mexico	10	262,260	25 x 30

* 3 cylinder.

Table VI—Principal orders for 0-8-0 locomotives in 1924

Road	No.	Weight, lb.	Cylinders, in.
Pennsylvania	50	275,000	27 x 30
Missouri, Kansas, Texas	10	248,000	26 x 26
Terminal Railroad of St. Louis	15	248,000	26 x 28
New York, New Haven & Hartford	10	245,000	22 x 28*
Missouri Pacific	5	224,490	25 x 28
Michigan Central	5	223,500	25 x 28
New York Central	50	219,000	25 x 28
Louisville & Nashville	8	217,000	25 x 28
Cleveland, Cincinnati, Chic. & St. Louis	20	216,500	25 x 28
New York, Chicago & St. Louis	10	216,500	25 x 28
Florida East Coast	11	215,000	25 x 28
Southern	30	214,000	25 x 28
Grand Trunk (in U. S.)	15	211,000	22 x 28

* 3 cylinder.

The 4-10-2 type, of which 16 were ordered by the Southern Pacific, is the first of this wheel arrangement. They are of the three-cylinder design, having a tractive force of 76,900 lb., not including the booster, and a weight of 306,000 lb. on the drivers.

Three-cylinder locomotive and high-pressure 2-8-0 of the D. & H. are the outstanding developments

Without doubt, the three-cylinder simple locomotive is the outstanding development for the past year. Table IV shows a total of 43 three-cylinder locomotives ordered in 1924. These locomotives are distributed among nine roads, 16 of the 4-10-2 type being ordered by the Southern Pacific and 10 of the 0-8-0 type by the New Haven.

The most striking motive power development which has

culminated within the past year is the Muhlfeld high-pressure, cross-compound 2-8-0 type locomotive of the Delaware & Hudson. This locomotive carries a working boiler pressure of 350 lb. and is rated at over 80,000 lb. tractive force, simple, and over 100,000 lb. with the tender booster in operation. The most apparent limitation of this locomotive is the unusually heavy load carried on the drivers which averages approximately 74,600 lb. per pair of drivers.

Tendencies as to size

An idea of the size of locomotives required to meet present-day operating conditions may be obtained by referring to Tables V to VIII inclusive, in which important orders for the leading types ordered in 1924 are grouped according to weight. Similar information for the 2-8-2, 2-10-2, 4-6-2 and 4-8-2 types of locomotives ordered in 1923 will be found on pages 77 and 78 of the February, 1924, issue of the *Railway Mechanical Engineer*.

Table VII—Principal orders for 4-6-2 locomotives in 1924

Road	No.	Weight, lb.	Cylinders, in.
Atchison, Topeka & Santa Fe	10	312,000	25 x 28
Pennsylvania	50	308,890	27 x 28
Chicago, Rock Island & Pacific	1	305,000	22½ x 28*
Missouri Pacific	1	302,500	22½ x 28*
Southern	15	299,000	27 x 28
Atlantic Coast Line	20	280,610	25 x 28
Louisville & Nashville	6	277,000	25 x 28
Philadelphia & Reading	10	273,600	25 x 28

* 3 cylinder.

Table VIII—Principal orders for 4-8-2 locomotives in 1924

Road	No.	Weight, lb.	Cylinders, in.
Illinois Central	25	362,500	28 x 28
Atchison, Topeka & Santa Fe	6	361,600	28 x 28
Los Angeles & Salt Lake	5	340,000	29 x 28
Canadian National	15	339,950	26 x 30
Florida East Coast	32	308,000	26 x 28

Of the 2-8-2 type, see Table IV, 12 of those listed are of the three-cylinder design. These locomotives stand fifth from the top of the list with weights of 334,000 lb. Both the Missouri Pacific and the Louisville & Nashville three-cylinder locomotives have the same size cylinders, 23 in. by 28 in. and 32 in. The 30 locomotives ordered by the Chesapeake & Ohio are exceptionally heavy. They weigh 350,000 lb. and have 20 in. by 30 in. cylinders. These locomotives are slightly heavier than those of the same type ordered in 1923 by the Delaware, Lackawanna & Western, which weighed 356,500 lb. and had 28 in. by 32 in. cylinders.

The order of 10 three-cylinder locomotives of the 0-8-0 type by the New York, New Haven & Hartford, shown in Table VI, is the only order for three-cylinder locomotives designed for switching service. These locomotives weigh 245,000 lb. and have 22 in. by 28 in. cylinders. The largest orders of the 0-8-0 type were the 50 ordered by the New York Central and an order for the same number placed by the Pennsylvania.

Table VII includes eight railroads and 113 of the 167 locomotives of the 4-6-2 type ordered in 1924. It will be noted that two 4-6-2 type locomotives of three-cylinder design ordered by the Missouri Pacific and the Chicago, Rock Island & Pacific have been included in this list. Table VIII includes five railroads and 93 of the 113 locomotives of the 4-8-2 type ordered. The Canadian National also ordered 6 locomotives weighing 339,000 lb. each, which are not included in this table. Of the 4-6-2 type locomotives, 72, or 43 per cent, weighed 300,000 lb. or over. Of the 4-8-2 type locomotives, 55, or 48.6 per cent, weighed over 350,000 lb. and none weighed less than 308,000 lb.

Comments on designs

Considerable may be learned from the tabulations as to the general type and size of locomotives that are being purchased. The eight-wheel type seems to be the most popular for switching service. The large number of orders placed for the 2-8-2 show that this type is still the general standard for freight traffic with a tendency for heavier models. The ordering of 10 three-cylinder locomotives of the 0-8-0 type by the New York, New Haven & Hartford is perhaps, with the exception of the "Horatio Ollen" ordered by the Delaware & Hudson, the most striking feature in the year's developments.

The popularity of the Mallet for heavy freight service

Table IX—Important motor equipment orders in 1924

Road	No.	Type	Length	Horsepower	Seating capacity	Weight	Builder
American R. R. of Porto Rico	3	Coach	57 ft. 0 in.	...	46	33,141	Wason Mfg. Co.
Boston & Maine	1	Motor	43 ft. 6 in.	70	38	29,000	J. G. Brill Co.
	1	Motor	51 ft. 2¾ in.	225	30	40,000	Sykes.
	1	Trailer	45 ft. 5½ in.	...	52	27,000	Sykes.
Canadian National	2	Storage battery	....	...	..	......	Int. Equip.
	2	Diesel electric	Equipments only	...	..	......	Westinghouse Electric.
Chicago, Burlington & Quincy	3	Motor	43 ft. 0 in.	60	41	41,600	Edwards.
Chicago, Great Western	2	Motor	44 ft. 7 in.	245	30	30,000	Sykes.
	2	Trailer	39 ft. 4 in.	...	44	21,000	Sykes.
Clev., Cinn., Chic. & St. Louis	4	Motor	35 ft. 0 in.	225	..	......	Sykes.
	4	Trailer	28 ft. 0 in.	...	60	......	Sykes.
	1	Motor	35 ft. 0 in.	150	..	......	Sykes.
Erie	7	Motor	43 ft. 6 in.	70	38	29,000	J. G. Brill Co.
	2	Motor	55 ft. 0 in.	250	50	50,000	J. G. Brill Co.
International Gt. Northern	2	Motor	42 ft. 7 in.	68	47	32,000	J. G. Brill Co.
	1	Motor B. & M.	42 ft. 7 in.	68	..	31.000	J. G. Brill Co.
	1	Trailer	42 ft. 7 in.	..	54	29,000	J. G. Brill Co.
Jonesboro, Lake City & Eastern	1	Gas-elec.	60 ft. 0 in.	175	50	96,000	General Electric.
	1	Gas-elec.	70 ft. 0 in.	175	91	96,000	General Electric.
Missouri Pacific	3	Motor	43 ft. 6 in.	70	38	29,000	J. G. Brill Co.
Morrissey, Fernie & Michel	1	Motor	32 ft. 0 in.	75	30	19,000	Edwards.
	1	Trailer	32 ft. 0 in.	..	34	15,000	Edwards.
	1	Motor	43 ft. 0 in.	100	50	41,000	Edwards.
New Orleans & Lower Coast	1	Motor	40 ft. 0 in.	90	36	26,000	F. W. D. Auto Co.
	2	Trailer	40 ft. 0 in.	...	40	22,000	F. W. D. Auto Co.
New York Central	1	Motor	55 ft. 0 in.	250	50	50,000	J. G. Brill Co.
	1	Motor	55 ft. 0 in.	150-200	..	55,000	J. G. Brill Co.
	1	Trailer	50 ft. 0 in.	...	60	30,000	J. G. Brill Co.
N. Y., N. H. & H.	10	Motor	42 ft. 7 in.	150	45	35,000	Sykes.
	10	Motor	42 ft. 0 in.	150	45	34,000	J. G. Brill Co.
	1	Gas-elec.	62 ft. 2 in.	250	65	70,000	J. G. Brill Co.
Northern Pacific	1	Gas-elec.	59 ft. 4 in.	175	59	78,400	Electro-Motive Co.
	1	Motor	58 ft. 10 in.	104	33	73,000	Oneida Mfg. Co.
	3	Gas-elec.	59 ft. 4 in.	175	58	78.400	Electro-Motive Co.
Pennsylvania	1	Motor	43 ft. 6 in.	70	38	30,000	J. G. Brill Co.
	2	Motor	44 ft. 5 in.	150	38	34,000	J. G. Brill Co.
	1	Trailer	18 ft. 6 in.	...	..	5,000	J. G. Brill Co.
Wichita Falls & Southern	1	Motor	43 ft. 6 in.	70	38	29,000	J. G. Brill Co.
	1	Motor-bagg.	55 ft. 0 in.	250	..	50,000	J. G. Brill Co.
	1	Trailer	55 ft. 0 in.	...	60	30,000	J. G. Brill Co.
Wilmington, Brunswick & Southern	1	Motor	32 ft. 0 in.	75	28	19,000	Edwards.
	1	Trailer	34 ft. 0 in.	...	40	16,000	Edwards.
	1	Frt. trailer	25 ft. 0 in.	...	..	12,500	Edwards.

appears to be on the decrease. In 1922 the orders for articulated locomotives amounted to 116. In 1923 the total number ordered by the railroads fell to 53 and only 34 articulated locomotives were ordered in 1924, of which 20 were ordered by the Union Pacific.

The Pacific, or 4-6-2 type, is evidently considered to be the best suited for ordinary passenger traffic if the large number ordered in 1924 may be taken as an indication. Seventy-three of the 167 locomotives of this type ordered weighed over 300,000 lb. The popularity of the Mountain, or 4-8-2 type, appears also to be in the ascendency, the orders placed in 1924 totaling 113. This type of locomotive has evidently found its place not only where long and heavy passenger trains have to be hauled in territory where grades are an important factor, but also for hauling fast freight.

Among the year's developments in this country that are also worthy of special mention are the oil-electric locomotives and the tendency towards locomotive tenders of large capacity. A recent order for fifty 15,000-gal. tenders for the New York Central is an example of the latter trend in equipment design.

The General Electric Company and the Ingersoll-Rand Company have built jointly an oil-electric switching locomotive which embodies the combination of a six-cylinder solid injection type oil engine and a direct current generator driving four motors without intervening accelerating resistances. This has resulted in a remarkably flexible and economical form of motive power, which if experience proves its practicability when adapted to units of greater hauling capacity, should materially aid in the efforts being made to utilize the oil engine with its low operating cost for the propulsion of railway locomotives.

Use of motor cars for handling light traffic increasing

The domestic orders placed in 1924 for rail motor cars amounted to 120. These cars are estimated to have a total value of $2,250,000. A total of 10 rail motor cars, including the two Diesel-electric equipments ordered from the Westinghouse Electric Company by the Canadian National, and two trailers were ordered by various Canadian roads. Among the important motor equipment orders shown in Table IX are the orders for 21 motor cars placed by the New York, New Haven & Hartford and for nine placed by the Erie. It will be noted from the list of types shown in Table X, that there is considerable variation in weight and horsepower not only between the cars built by different manufacturers but by the same manufacturer as well. The lengths of the various types of motor cars run from as low as 32 ft. to as high as the 70-ft. cars built by the General Electric Company for the Jonesboro, Lake City & Easton.

The tendency in design continues toward the development of cars with a larger power reserve. This is a natural trend because it is not economical to require a gasoline engine to run continuously at high points on the horsepower curve, for an overloaded engine requires frequent repairs which result in high maintenance costs. Among the various auxiliaries on rail motor cars, the lighting arrangement has given the most trouble. Storage batteries for lighting purposes have not given entirely satisfactory results and independent lighting equipment is coming into use. The possibility of the application of axle lighting equipment to rail motor cars has received some consideration, but this is still a problem for the future.

The present tendency is toward lightening of the superstructure and increasing the ruggedness of the trucks. The past year has seen an effort to conserve floor space by placing the power units under the floor of the car. This seems to be a step in the right direction as floor space is an important factor in cars of this type, in which the weight limitations are necessarily severely restricted.

Table X—Types of motor equipment ordered in 1924

Builder	No.	Type	Horse Power	Weight	Length	Seating Capacity
J. G. Brill Co.	24	motor	70	29,000	43 ft. 6 in.	38
	7	motor	250	50,000	55 ft. 0 in.	50
	1	trailer	...	24,000	34 ft. 0 in.	36
	2	motor	68	32,000	42 ft. 7 in.	47
	1	motor B. & M.	68	31,000	42 ft. 7 in.	..
	2	trailer	..	29,000	42 ft. 7 in.	54
	2	trailer	..	30,000	50 ft. 0 in.	60
	1	motor	150-200	55,000	55 ft. 0 in.	..
	10	motor	150	34,000	42 ft. 0 in.	45
	2	gas.-elec.	250	70,000	62 ft. 2 in.	65
	2	motor	150	34,000	44 ft. 5 in.	38
	1	trailer	..	5,000	18 ft. 6 in.	..
	1	trailer	..	30,000	55 ft. 0 in.	60
Calif. Body Bldg. Co.	1	motor	80	16,400	33 ft. 0 in.	33
Edwards	9	motor	75	19,000	32 ft. 0 in.	30
	3	motor	75	20,000	34 ft. 0 in.	40
	3	motor	60	41,600	43 ft. 0 in.	41
	1	motor	206	48,000	51 ft. 0 in.	50
	2	trailer	..	16,000	34 ft. 0 in.	40
	1	frt. trailer	..	12,500	25 ft. 0 in.	..
	1	motor	100	41,000	43 ft. 0 in.	50
	1	trailer	..	15,000	32 ft. 0 in.	34
Electro-Motive Co.	4	gas.-elect.	175	78,400	59 ft. 4 in.	58
F. W. D. Auto Co.	1	motor	90	26,000	40 ft. 0 in.	36
	2	trailer	..	22,000	40 ft. 0 in.	40
Ford	1	motor	..	6,000	24 ft. 0 in.	20
General Electric	1	gas.-elect.	175	96,000	60 ft. 0 in.	50
	1	gas.-elect.	175	96,000	70 ft. 0 in.	91
International Equip.	2	storage battery	..	.....	....	..
	1	storage battery coach	..	71,200	52 ft. 3 in.	50
International Motor Co.	1	motor	60	22,500	37 ft. 7⅜ in.	41
	1	motor	120	48,000	54 ft. 0 in.	44
Oneida Mfg. Co.	1	motor	208	66,000	70 ft. 0 in.	32
	2	motor	140	67,000	70 ft. 0 in.	62
	1	motor	140	65,000	68 ft. 0 in.	38
	1	motor	104	73,000	58 ft. 10 in.	33
	1	motor	45	7,500	14 ft. 0 in.	14
Ry. Storage Battery Car	2	pass. & bagg.	..	.....	55 ft. 0 in.	..
Sykes	1	motor	225	40,000	51 ft. 2¾ in.	30
	1	trailer	..	27,000	45 ft. 5½ in.	52
	2	motor	245	30,000	44 ft. 7 in.	30
	2	trailer	..	21,000	39 ft. 4 in.	44
	4	motor	225	.....	35 ft. 0 in.	..
	1	motor	150	.....	35 ft. 0 in.	..
	2	trailer	..	.....	28 ft. 0 in.	60
	2	trailer	..	.....	28 ft. 0 in.	..
	10	motor	150	35,000	42 ft. 7 in.	45
	1	motor	150	24,000	41 ft. 10 in.	38
Wason Mfg. Co.	3	coaches	..	33,141	57 ft. 0 in.	46
Westinghouse Electric	2	Diesel-Elec	..	.....	equipment only	..

Fuel economy at power plants on the S. P.

THE Southern Pacific has for many years made strenuous efforts to reduce its fuel consumption in train service with the result that it is in the first rank among railroads of this country with respect to its fuel record. In the latter part of 1923 attention was also called to the possibility of savings in fuel at stationary boiler plants with the result that a fuel committee was formed on the Texas Lines, consisting of the superintendent of motive power, the chief engineer and the engineer of fuel and water service. A competent assistant engineer was employed and a systematic plan devised for the thorough and periodical inspection of all boiler plants; with recommendations for changes in installations, which were studied and passed on by the fuel committee at monthly meetings, and the systematic instruction of boiler plant employees in the operation of the plants.

On the Texas and Louisiana Lines of the Southern Pacific there are 94 stationary boiler plants of various sizes and uses, varying from large plants at shops and terminals to small plants at water and oil stations, etc. All of these plants burn crude oil as fuel and the total cost of the oil consumed in 1923 was over $600,000.

How the H. & T. C. power plant was improved

The H. & T. C. power plant, before recent improvements were made, consisted of one 120-hp. Heine water tube boiler and two 160-hp. Erie City horizontal water-tube boilers, all set singly, their uptakes being connected into a breeching leading to one brick stack 100 ft. high. These boilers supplied steam to operate two 12-in. by 8½-in. by 12-in. duplex Union Steam Pump Company's pumps, used for washing and filling engines, two 12-in. by 10-in. by 12-in. duplex Worthington water pumps for pumping water from sump to stand pipe, one Knowles 14-in. by 7¼-in. by 12-in. Underwriter's fire pump, two 7½-in. by 5-in. by 6-in. duplex Worthington boiler feed pumps, one 500-cu. ft. duplex steam-driven air compressor, one 18-in. by 24-in. simple steam engine for driving machine shop tools and five oil pumps.

During the summer, after a majority of the improvements had been completed and the fuel consumption had been reduced about 40 per cent, it was found that the load could be carried by one boiler. One boiler supplied all steam necessary until the sleet storm on December 19. This operation of one boiler resulted in further fuel savings by firing one boiler at full load in place of two boilers at less than rating and by eliminating large radiation losses from the second boiler. It also provided a large margin of reserve.

Comparative requirements for steam

The requirements for steam during 1923 and 1924 were approximately the same. The same principal equipment was in service such as compressors, engines, water and oil pumps. During 1924, there was put into operation a hot water washing and filling system which replaced one small pump using cold water with two larger pumps for handling hot water. There was also installed an auxiliary oil tank for the power plant with two small oil pumps for pumping oil direct to the burners. The oil pump which formerly pumped oil to the burners through about 800 ft. of two-inch line at a pressure of 240 lb. per sq. in. now pumps oil through a three-inch line to the auxiliary tank.

The following is an itemized statement of the improvements made and the cost of each:

Installation of 2-in. line to waste-reclaiming plant to use exhaust in place of live steam	$90
Connections from hot water washing and filling tank to boiler feed pumps	150
Installation of 6 Hammel oil burners and air chamber on oil line to reduce steam for atomization and improve combustion	340
Hose, boiler tube cleaner and Navy boiler compound	140
Use of hollow staybolt steel plugs and plastic cement to prevent entrance of cold air to furnace	50
Installation of oil meters	100
Removal of 250 ft. of dead-end steam pipes	25
Insulation of steam pipes in boiler room	150
Insulation of ends of boiler drums	150
Installation of lubricated blow-off valves to prevent leaks and reduce repairs and maintenance of previous valves	45
Connections to utilize exhaust in place of live steam to heat oil for burners	20
Installation of steam traps to prevent waste of steam	110
Installation of 400-hp. feedwater heater	1,238
Repairs to dampers to make them adjustable	25
Installation of steam soot blowers to facilitate effective removal of soot from tubes	50
	$2,683

In view of the fact that the H. & T. C. handles only passenger engines and that all demands upon the power plant vary with the engines handled, the number of engines washed each month represents the most accurate index of output of the plant. This demand upon the plant consists of steam for firing up engines, power in the machine shop, air and oil and water supply. The demand increases in winter due to the necessity for heating a few buildings and for heating oil. The following is a record of all engines which were washed or had their water changed, this being the only official and accurate record available. This work necessitates washing, filling, pumping and heating oil, pumping water and a due percentage of other mechanical operations.

Engines washed or having water changed at H. & T. C. terminal

Month	1924	1923
January	554	462
February	550	435
March	587	486
April	553	492
May	572	527
June	594	527
July	663	570
August	605	566
September	499	545
October	486	569
November	451	560
December	542	561
Totals	6,656	6,300

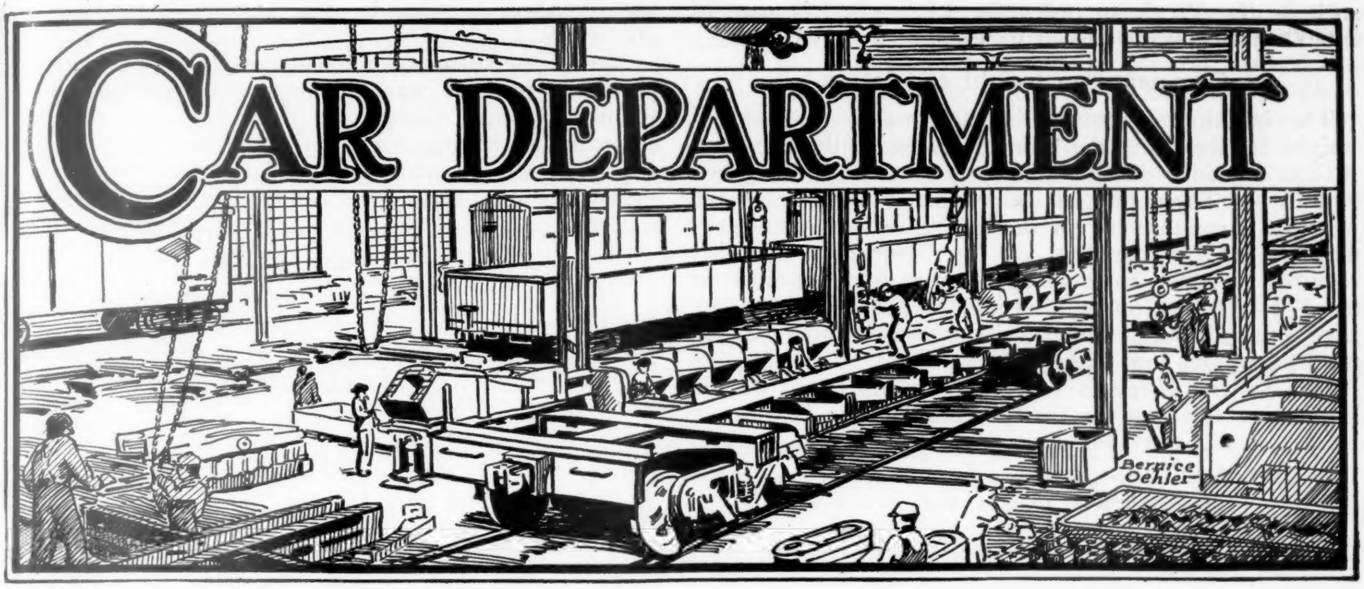
Quantity of fuel by months—1924 price per gallon

Month	Gal. of oil 1924	Gal. of oil 1923	Average price per gal. 1924
January	112,500	88,827	$0.03545
February	92,816	73,640	0.03496
March	90,903	100,948	0.03467
April	83,511	101,800	0.03451
May	78,294	93,425	0.03352
June	65,685	88,177	0.03418
July	62,698	95,391	0.03401
August	59,567	107,820	0.03439
September	59,480	97,633	0.03398
October	63,312	91,710	0.03276
November	56,367	107,610	0.03231
December	77,474	112,963	....
Totals	902,607	1,159,944	$0.37474
Average			$0.03407

In order to determine the savings made at this plant, three methods may be used. First, the difference in the total oil burned in the two years, 257,337 gal. at the average price of oil, $.034 per gal., is $8,749 a year.

A second method would be to compare the last six months of each year. This more nearly reflects the rate of savings, as most of the important improvements were completed during the first half of 1924. This difference is 613,127—378,898, or 234,229 gal., which at $0.034 a gal. equals $7,964 in the six months. This is equivalent to $1,327 a month or $15,924 a year.

A third method would be to base the savings on the fuel record for December of the two years, as in each case it was obtained from an oil meter and is accurate. December, 1924, included several unusual days of ice and sleet and might not indicate the full savings. On this basis the reduction in fuel is 35,489 gal., which at $0.034 a gal. is equal to $1,206 a month or $14,472 a year. These improvements were made under the direction of H. M. Lull, chief engineer, Southern Pacific, Texas Lines.



Car orders placed during 1924

Last year shows a marked increase in equipment orders placed by railroads in the United States

ORDERS for both freight and passenger equipment placed in 1924 by the railroads were of an exceptional volume. Freight cars ordered for service in the United States totaled 143,728. This compared with the 94,471 in 1923 and 180,154 in 1922. Except for 1922 the 1924 total was the largest for any year since 1916. Passenger cars ordered for service on the railways of the United States totaled 2,554, which compared with the orders for 2,214 cars in 1923 and 2,382 cars in 1922; it was the largest number ordered in any year since 1913.

Freight car orders

The Canadian orders for cars placed with Canadian builders totaled only 1,867, as compared with 8,685 in 1923.

The National Railways of Mexico ordered 1,740 cars from builders in the United States; other export business amounted to 2,277 cars.

Table I—Orders for freight cars since 1915

Year	Domestic	Canadian	Export	Total
1915	109,792	......	18,222	128,014
1916	170,054	......	35.314	205,368
1917	79,367	......	53,191	132,558
1918	114,113	9,657	53,547	177,317
1919	22,062	3,837	3,994	29,893
1920	84,207	12,406	9 056	105,669
1921	23,346	30	4,982	28,358
1922	180,154	746	1,072	181,972
1923	94,471	8,685	396	105,552
1924	143,728	1,867	4,017	149,612

Freight car production in 1924 totaled 113,761 cars, as compared with 175,748 cars in 1923. Up to April 30, 1924, orders had been placed for about 70,000 cars. There were, however, practically no orders placed during the following four months. Freight car purchases reported in May, June and July together totaled only 1,355 cars, and those reported in August but 4,751 cars. Improved conditions in September, and since, have changed the situation with the result that, unlike 1923, as much business was placed by the railroads for this class of equipment in the second half of the year as in the first half.

The year 1924 was characterized by some unusually large orders. The New York Central Lines purchased over 20,000 cars. The Pennsylvania purchased one lot of 12,000 in the spring, and another of 10,000 in September, all A.R.A. standard cars and totaling in value $46,500,000. The Illinois Central purchased 6,200 freight cars, and its total purchases of equipment aggregated $25,000,000. Other large purchases included the Norfolk & Western, 11,000; the Louisville & Nashville, 5,700; the Southern Railway, 8,948; the Chesapeake & Ohio, over 10,000; the Missouri Pacific, not including its subsidiary, the American Refrigerator Transit Company, over 4,000; the Reading, 4,050; the Atchison, Topeka & Santa Fe, 7,200, etc.

The types of freight cars ordered for service in the United States, Canada and Mexico are shown in Table III. None of the cars ordered were of unusual capacity,

Table II—Freight cars built in 1924

	United States	Canada	Total
Domestic	113,761	1,721	115,482
Foreign	1,141	....	1,141
	114 902	1,721	116,623

	United States			Canadian			
	Domestic	Foreign	Total	Domestic	Foreign	Total	Grand Total
1913	176,049	9,618	185,667	22,017	......	22,017	207,684
1914	97,626	462	98,088	6,453	......	6,453	104,451
1915	58,226	11,916	70,142	1,758	2,212	3,970	74,112
1916	111,516	17,905	129,421	......	......	5,580	135,001
1917	115,705	23,938	139,643	3,658	8,100	11,758	151,401
1918	67,063	40,981	108,044	14,704	1,960	16,664	124,708
1919	94,981	61,783	156,764	6,391	30	6,421	163,185
1920	60,955	14,480	75,435	......	......	......	......
1921	40,292	6,412	46,704	8,404	745	9,149	55,853
1922	66,289	1,126	67,415	458	100	558	67,973
1923	175,748	2,418	178,166	......	......	......	......
1924	113,761	1,141	114,902	1,721	......	1,721	116,623

such as the Virginian order for 1,025 gondola cars of 240,000 lb. capacity, placed in 1923.

Comments on freight car design

The question of outstanding interest in the field of freight car design is the ultimate status of the proposed A.R.A. standard designs for single and double-sheathed box cars. These designs, which are the result of the work of a committee representing more than two-thirds majority of the members of the Mechanical Division required to secure their adoption, were first presented at the 1923 meeting of the division. Since that time they have been through many vicissitudes of letter ballots, reconsiderations and slight modifications and the double-sheathed steel design is now back in the hands of the Mechanical Division for further consideration because of considerable objection to the inside dimensions on the part of the members of the general committee of the Mechanical Division. Until the future status of these designs is completely settled, there will probably be no marked innovations in the design of the types of equipment to which they apply and on this settlement probably depends the future activity of the Mechanical Division with respect to other types of cars.

Table III—Types of freight cars ordered in 1921 for use in the United States, Canada and Mexico

Type	Number	Per cent
F.—Flat and Logging	4,103	2.8
G.—Gondcla	26,229	17.8
H.—Hopper	18,674	12.7
R.—Refrigerator	14,447	9.8
S.—Stock and Poultry	5,836	3.9
T.—Tank	3,439	2.3
X.—Box	54,600	37.0
Automobile	15,082	10.2
Ballast, Dump and Ore	2,726	1.8
Not classified	1,489	1.0
N.—Caboose	710	.5
	147,335	100.0

But notwithstanding the long uncertainty as to their fate, these designs and the recently adopted standard construction details of the Mechanical Division are having a real influence on car construction. While few railroads have specified complete adherence to them, they are serving as the basis or point of departure in the design of much of the box car equipment built or building in 1924. The A.R.A. standard center sill sections are gaining adherents and are being employed in new construction to a considerable extent in spite of an unfavorable price differential charged for these sections by the mills, as compared with standard structural material. This handicap, however, can hardly be considered as permanent and, as the demand increases the tonnage of these sections, they will undoubtedly be obtainable at current structural steel prices.

Table IV—Orders for passenger cars since 1916

	Domestic	Canadian	Export	Total
1916	2,302	...	109	2,411
1917	1,124	...	43	1,167
1918	9	22	26	57
1919	292	347	143	782
1920	1,781	275	38	2,094
1921	246	91	155	492
1922	2,382	87	19	2,488
1923	2,214	263	6	2,483
1924	2,554	100	25	2,679

Passenger car orders

The production of passenger train cars for domestic service in the United States totaled 2,150, as compared with 1,507 in 1923. The 1924 production was the largest reported since 1914, in which year 3,310 cars were built. Railways in Canada placed orders for 100 passenger cars with builders in Canada, this amount comparing with 263 in 1923.

One of the reasons for the large total of passenger car purchases in 1924 was the large authorizations of cars for the Pullman Company. The total reported by the company as having been authorized to be constructed for Pullman Company service was 506, inclusive of parlor, sleeping, library and even a few dining cars. This number was considerably above the amount ordinarily authorized by that company and presumably results from the attention that is being given to high grade passenger service throughout the country. The railroads, of course, were large buyers and several very sizable orders were reported, including notably one lot of 215 suburban cars for the Illinois Central, in addition to 66 through line cars. Another large buyer was the New York Central Lines, which together placed orders for no less than 394 cars.

Table V—Passenger cars built in 1924

	United States	Canada	Total
Domestic	2,150	167	2,317
Foreign	63	...	63
	2,213	167	2,380

Comparison with Previous Years

Year	United States Domestic	United States Foreign	United States Total	Canadian Domestic	Canadian Foreign	Canadian Total	Grand Total
1913	2,559	220	2,779	517	....	517	3,296
1914	3,310	56	3,366	325	....	325	3,691
1915	1,852	14	1,866	83	....	83	1,949
1916	1,732	70	1,802	37	....	37	1,839
1917	1,924	31	1,955	45	....	45	2,000
1918	1,480	92	1,572	1	....	1	1,503
1919	306	85	391	160	....	160	551
1920	1,272	168	1,440	...	....	...	...
1921	1,275	39	1,314	361	....	361	1,675
1922	676	144	820	71	....	71	891
1923	1,507	29	1,536	...	....	...	...
1924	2,150	63	2,213	167	....	167	2,380

During the war period and immediate post-war passenger car purchases were small. In 1918, for example, there were orders for only 9 cars; in 1919, for only 292, and in 1921 for but 246. For the past three years the railways have had opportunity to catch up on the deferred requirements. They have particularly made marked progress with reference to replacing wooden with steel equipment.

Table VI—Types of passenger equipment ordered for use in the United States and Canada

Type	1922	1923	1924
Coach, combination, passenger, etc	1,337	736	952
Sleeping, parlor, chair, etc	248	488	543
Dining	71	76	133
Baggage, express, mail	486	415	555
Express refrigerator	270	400	410
Milk	25	323	12
Horse	19	16	34
Private, business, miscellaneous	9	15	15
	2.465	2,469	2.654

Information relative to the types of passenger cars ordered in 1922, 1923 and 1924 will be found in Table VI, which includes all the cars ordered for service in the United States and Canada.

Interior arrangements and finish are principal developments in passenger car design

In considering the developments of 1924, little can be said with respect to the structural design of passenger cars. The principal developments have had to do with interior arrangement and with more originality of expression in the esthetic side of interior finish.

The most pronounced innovation during the year was probably the adoption of an unsymmetrical seating arrangement in cars used for suburban service, which

provides for two persons per seat on one side of the aisle and three persons per seat on the other side of the aisle. The maximum seating capacity is thus increased by approximately one-fourth in a class of service where seating capacity is at a premium during comparatively short periods of time. This arrangement is used notably on the New York, New Haven & Hartford in the east and on the Missouri Pacific in the west.

The Pullman Company during the past year has developed a distinctive treatment of the interior decorations of its parlor cars for use on certain preferred lines which not only adds variety to the general character of interior appearance, but represents in itself a most pleasing and harmonious effect. Apparently the reaction from the elaborately carved and over-decorated type of interior finish commonly incorporated in all cars 40 years ago has run its course and the period of monotonous severity of interior treatment is ended.

To increase output of coach repairs

Use of straight line methods proposed in two alternate shop designs

By Lawrence Richardson
Whiting Corporation, Chicago

THE gratifying results obtained from the application of straight line principles to freight car repair shops warrant their consideration for passenger car and locomotive shops. In one case the increase in production per man hour on freight car work was 48 per cent. To secure this increase large additional facilities would be warranted but actually the necessary changes in old shops are small and new shops can be constructed on a straight line basis at little, if any, additional cost.

Straight line passenger car repair shop layouts are shown in diagrammatic plan in Figs. 1 and 2. The main thought has been to bring out the basic principles rather than to try to show the details of an actual layout. Available property invariably sets up limitations that call for a special study of each case. This fact is recognized in the two layouts shown, one being for a long narrow area and the other for a property more nearly a square. The principles in both layouts are the same.

While a uniform run of work and production is necessary in straight line freight car shops, it is not as essential in passenger car shops. Repetition with increasing speed results in the first case while reduction in the movement of material is the basic idea in the passenger car layout. A study of the time actually spent working and that spent moving or getting material shows that these are about equal. Reduction of the percentage of unproductive time is the main idea worked out in the layouts shown. A limited specialization is also possible.

The basis of the layouts is an inbound track where the operations are performed in their usual sequence, and an outbound track where the operations are performed in the reverse sequence. The individual shops are laid out between the inbound and outbound tracks so as to permit direct straight line movement of the material from one track to the other. The distance between these tracks is made a minimum, consistent with the amount of space required for the repairs. This in turn reduces the movements to a minimum. All the worn parts start moving from the inbound track through the repair operations to the outbound track where they accumulate as repaired parts, movement being in one direction only. If any operator does not hold the required pace and keep up to the schedule, the work will pile up back of him. The effect of this is to speed him up in an effort to hold his own. Sometimes he hardly realizes that he is being forced—at other times, he is anxious to avoid the remarks of his fellow-workmen. In either case, it is not necessary for the foreman to drive the man. It thus automatically helps to eliminate the chief source of friction in a shop.

Under the old system, a pile of material did not indicate much. Under straight line production, it immediately points to delay and trouble. In this way a foreman can easily see where his attention is needed. Instead of running around a large part of the time, he can devote the bulk of his efforts to strengthening his organization and perfecting methods. In discussing straight line production with a foreman in a manufacturing car shop, he made the statement that about all he had to do was to blow the whistle every hour. If any particular stage did not shift, he could locate it at once. His main effort was bent on breaking in new men and checking the condition of tools.

The value of shop schedules seems to be an agreed fact. However, there is a tendency among men accustomed to other methods to forget them. Straight line production demands a close adherence to schedule, thus assuring the benefit to be gained from this method of operating shops.

The localization of stripping and fitting is advantageous. Since all of the stripping is done at one point, the bulk of the dirt is kept from the shop proper. This makes it much easier to keep the premises clean. Inspection is also centralized. In doing the bulk of the fitting on the outbound track, it is possible to have specialized gangs do this work. An increase in production of 50 per cent in such cases is not unusual. Benches and special machines can be located adjacent to such points, so that the men can get the full benefit of them. It is a case of less walking and more working. This point can be better appreciated by considering a shop 700 ft. long. A walk to one end and back means one-quarter of a mile. This is not unusual. Pedometer tests on workmen have shown surprising distances covered in the course of a day's work.

Inasmuch as the finishing work is done on one outbound track, it is possible to make all the necessary final inspections without traveling through the shop. This results in better and more efficient supervision. As the inspectors have a permanent location, it is possible for them also to assume supervisory duties, thereby reducing the overhead charges. Some roads prefer to have the re-trucking and final inspection made outside in order to get the benefit of full daylight. In this case, the outbound track would be just outside the shop instead of just inside as shown.

The individual shops are arranged in the sequence in which the work is to be done, the first operation being the

removal of batteries. Therefore, the battery shop is the first shop on the inbound track. In view of the tendency to separate the battery shop from the rest of the repair shops, on account of the fumes and other features, it has been shown in a separate building. The worn batteries are received at one end of the shop, moved through the shop as they are repaired and dispatched through the opposite end in good condition. At this point they meet the outbound car in its last position where they are replaced just before the car is turned out for service. In many cases, the battery shop also takes care of batteries operations. To handle the truck work properly, this shop should be provided with crane service. It is possible to give this crane enough capacity to untruck the cars although the more economical way would be to provide a lower capacity crane capable of handling a truck. The cars could then be untrucked by the use of portable coach hoists, or jacks, the crane being used for removing the trucks and handling them through the truck shop. Shop trucks are used for the movement of the car body to and from the main shop. The shop trucks released from the outbound cars are moved across the truck shop and placed

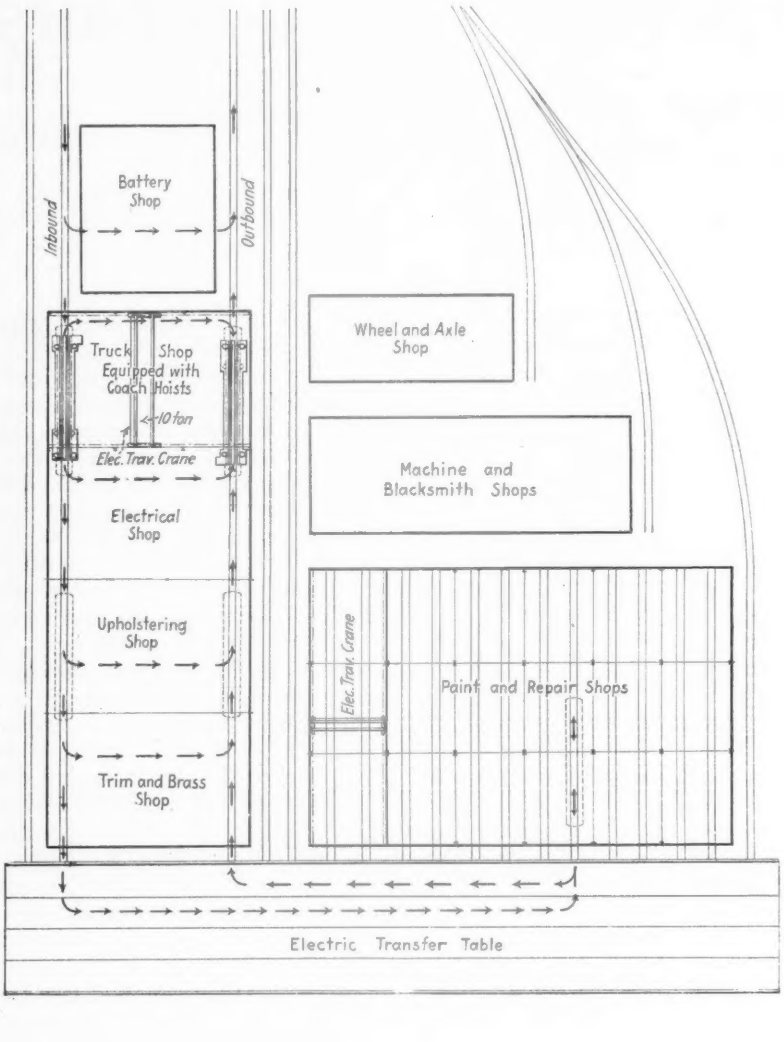


Fig. 1—Straight line passenger car shop layout for an approximately square area

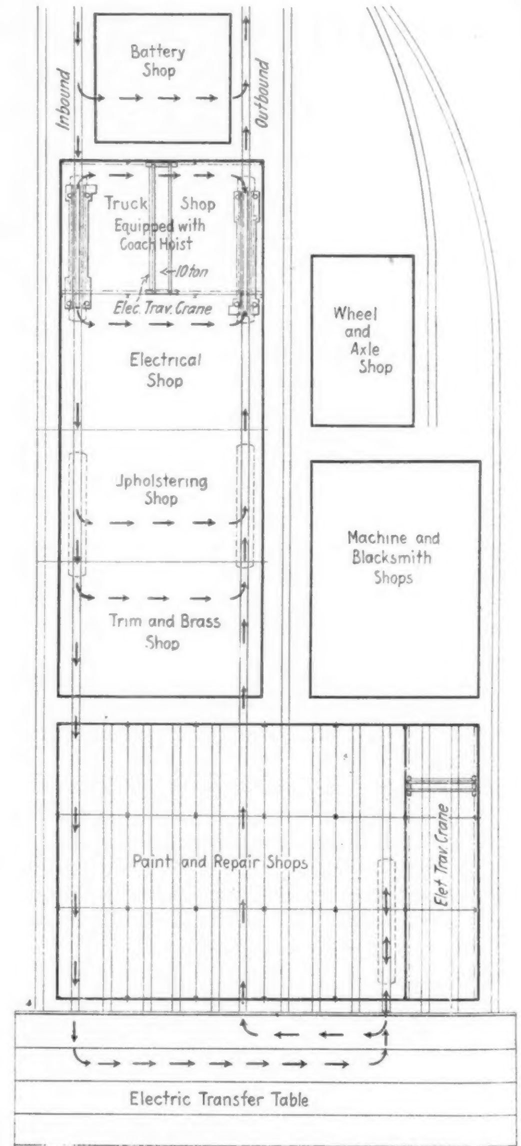


Fig. 2—Straight line passenger car shop layout for a long, narrow area

shipped in from road points. Such shipments can be readily handled in the layout shown without interference with the current repair work.

Design and location of truck and wheel shops

While the location of the truck shop is more or less optional, it has been shown in this location in order to make it adjacent to the wheel shop. In view of the fact that the wheel shop does as much work for outside points as it does for the repair shop, it has been located so that carloads of wheels received from outlying points may be moved in or out without interfering with the general shop under the inbound cars. When the shop is running full capacity, as soon as one car is finished, another one to be repaired takes its place. The one turned out releases a track—and a pair of trucks—to the inbound car. This means that no storage of shop trucks is required. Only when a truck is left unoccupied is it necessary to store shop trucks.

The electrical shop is located next, in order to handle the electrical generators from the trucks as well as electrical apparatus from the cars. The movement through the electrical shop conforms to the general principles mentioned in connection with the truck and battery shops.

The upholstering shop is next. The space for this shop may be a second floor above one of the other shops as only light machinery is required and the cushions and chairs are easily handled. If necessary, storage may be provided in mezzanine galleries. The trimmings and brass work are removed at the last position and moved through the trimming and brass shop in accordance with the principles mentioned.

If desired, this last space may be separated from the shop proper and used as a scrubbing room. In this way, an extra move can be saved before placing the car bodies in the general repair shops.

The number of stops on the inbound and outbound tracks may be regulated to suit the production required. If the output is limited, two stops will be found sufficient as indicated by the dotted lines. If the output is increased, it can be taken care of by increasing the

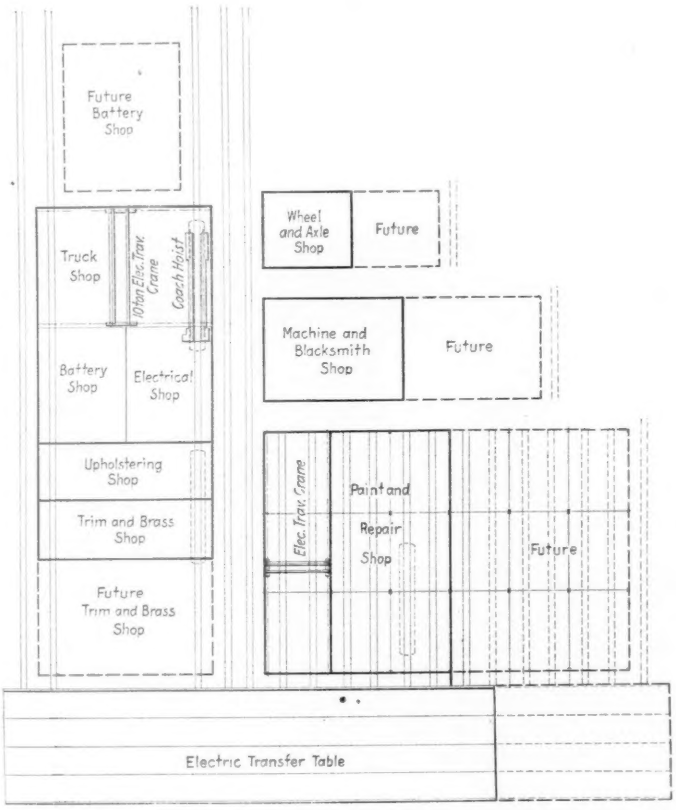


Fig. 3—A small shop layout on the straight line principle with provision for expansion

stops, space having been provided so as to make this number as high as five.

Movement of cars

The movement of the cars from stage to stage may be accomplished in several ways. No one way is best in all cases as conditions vary widely. The weight of the cars has an important bearing. The four methods usually employed are: (1) By a shifter or tractor, (2) by a winch, (3) by hand movers, or (4) by gravity. The last method is to be preferred, when possible to use it, on account of the minimum effort and time required. If the track is given 5 in. drop per hundred feet, the car can be moved readily. With this fall, the car will not start itself. On the other hand, in summer weather, when started, it can be kept moving easily. Sometimes it only requires pushing by hand. Hand car movers are used to give it a start.

After the car is stripped and scrubbed it is removed to the general repair shop by means of a conventional type of transfer table. Here it is painted and given repairs in accordance with usual practice. Both operations may be done in one shop or there may be separate repair and paint shops. The largest owners of special and passenger cars have found it satisfactory to do both operations in one shop. This saves several moves. The use of ovens for baking or drying calls for additional moves.

Cars, including wrecks, which need extra heavy repairs, require a considerable amount of heavy lifting. This can best be accomplished by the use of cranes. As the number is usually small, only two tracks have been set apart for this purpose.

The short span gives a low cost crane. This heavy repair shop should be walled off from the other tracks on account of the dust raised as well as the noise.

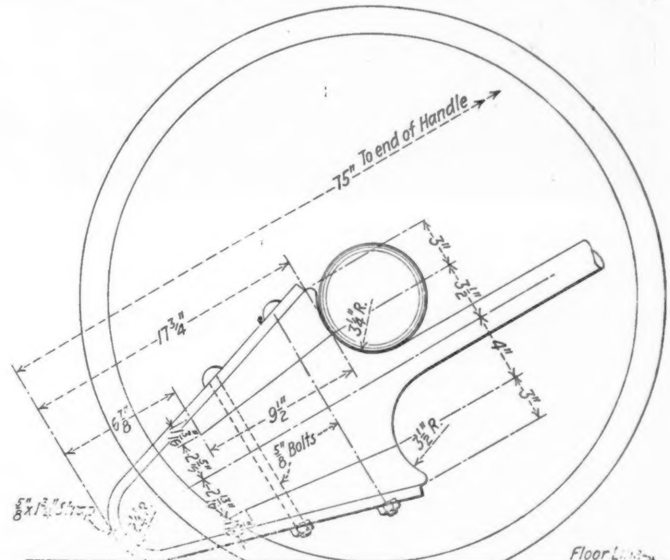
Small shop layout

In cases of roads not having enough equipment to warrant separate inbound and outbound layouts, it is possible to use one track for the purpose at first. Expansion can then be effected by transferring one of the operations to a far track. The development is shown in Fig. 3.

It will be noted that the first cost of the layouts shown is approximately the same as for standard shops. If anything, the first cost should be less as the faster movement requires less space. This makes the economy effected by the increased man-hour productions a net gain.

Wheel stick with renewable blocks

THE simple wheel stick has long served a useful part in practically every car repair yard and shop. In the accompanying drawing is shown one that is in use at the North Billerica Shops of the Boston & Maine, which appears to be a real improvement over the usual type in that the ease of renewal of worn parts has been taken into consideration. Except for the 5/8-in. by 1 3/4-in. strap iron



Method of using wheel stick

around the outside of the head, the whole device is constructed of straight grained hardwood. The strap iron protects against wear where contact is made with the floor or ground and, at the point where the axle rests on the wood, it will be noticed that renewable blocks are provided. Round head bolts hold the parts of the head in place and renewal of parts can be rapidly accomplished.

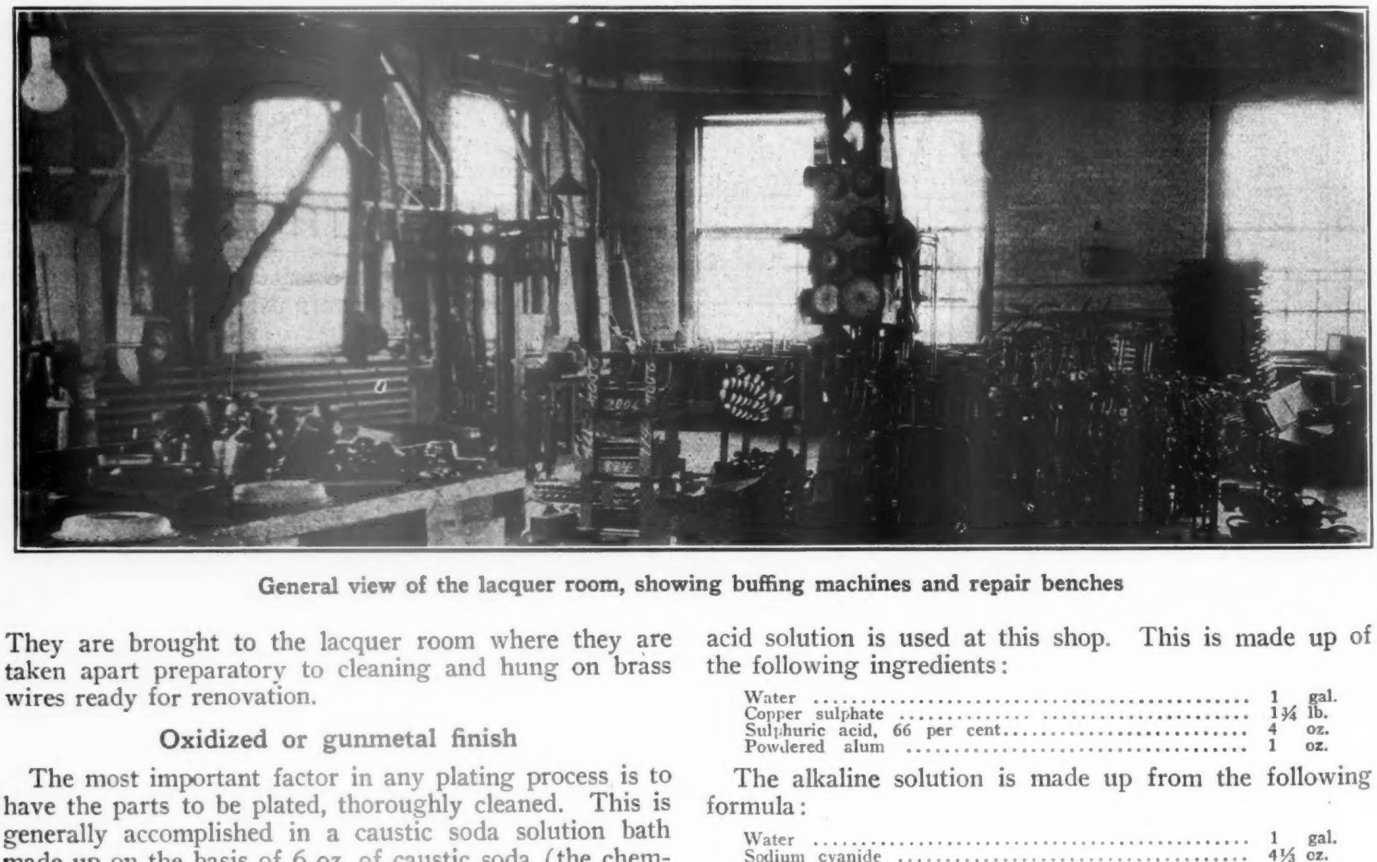
Renovating interior trimmings of passenger cars

A discussion of copper, nickel and silver plating processes used at the Billerica shops of the Boston & Maine

Part II

THERE appeared in the January issue of the *Railway Mechanical Engineer* a complete description of the methods used, at the Billerica shops of the Boston & Maine, of renovating passenger car seats in the upholstering department. On the same floor and connected to this department is the lacquer room in which modern methods are employed in copper, nickel and silver plating.

The brass trimmings of passenger cars, such as baskets, oil and gas lamps, seat arm caps, window fixtures, etc., are removed from the cars by the outside stripping gang. They are brought to the lacquer room where they are taken apart preparatory to cleaning and hung on brass wires ready for renovation.



General view of the lacquer room, showing buffing machines and repair benches

Oxidized or gunmetal finish

The most important factor in any plating process is to have the parts to be plated, thoroughly cleaned. This is generally accomplished in a caustic soda solution bath made up on the basis of 6 oz. of caustic soda (the chemical name is sodium hydroxide) to one gallon of boiling water. The parts to be cleaned are left in this bath from two to three hours, after which they are rinsed in clean hot water.

The parts are now black with a coating of dirt and lacquer which cannot be removed by caustic soda. This black coating is removed by dipping the work in a sulphuric acid bath, which consists of 60 per cent oil of vitriol and 40 per cent nitric acid. It is contained in an earthenware tank surrounded by cold water. The tank is kept filled by adding more acid to it each day until waste matter collects on the side of the tank. This indicates that the mixture is saturated with dirt and should be renewed. Every precaution should be taken to protect the workmen from the poisonous fumes which come from the acid. The parts are dipped in the acid twice and rinsed off in clean hot water. The brass parts now have their original bright appearance.

Method of copper plating

The plating is done in tanks containing 500 gallons of a solution made up according to the still solution formula. The acid or alkaline copper solution may be used. The acid solution is used at this shop. This is made up of the following ingredients:

Water	1	gal.
Copper sulphate	1¾	lb.
Sulphuric acid, 66 per cent	4	oz.
Powdered alum	1	oz.

The alkaline solution is made up from the following formula:

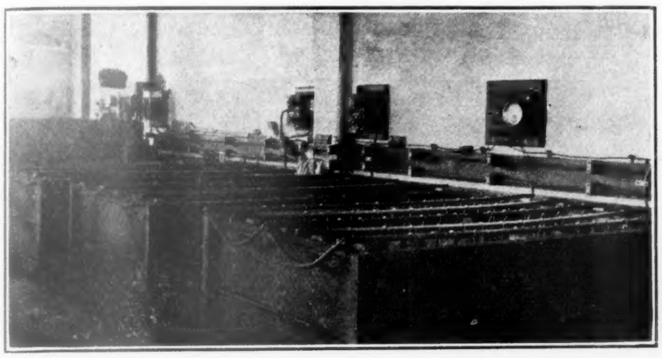
Water	1	gal.
Sodium cyanide	4⅓	oz.
Copper cyanide	4	oz.
Bicarbonate of soda	¾	oz.
Bisulphite of soda	½	oz.

The barrel or mechanical methods of plating are sometimes used. These necessitate increasing the proportions given above to twice the amount. As a rule, for mechanical solutions, the sodium cyanide and conducting salts will have to be increased 25 per cent above the amounts given for the still solutions; even though the proportions of the basic formula have been doubled.

Each tank has 18 copper anode plates which are 99 per cent copper and one per cent zinc and weigh from 12 to 14 lb. apiece. The parts to be plated are hung on the

cathode rod and remain in the tank 30 min., after which they are removed and rinsed in clean water. The electric current used in the plating process is eight volts and from 160 to 200 amperes controlled by suitable meters.

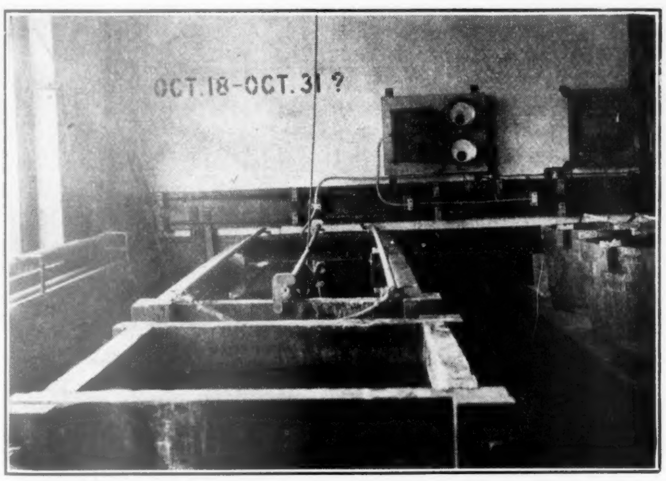
The work is now ready for the liver of sulphur bath. The chemical name for this bath is potassia of sulphurated merck. It is made up in a 150-gal. tub three times a week by mixing 5 lb. of liver of sulphur and a quart of ammonia to the tub. The parts are dipped in and out of this bath to give them the gunmetal finish. They are then rinsed in clean water and dried by compressed air, after



Copper and nickel plating vats

which they are given a scratch brush finish. The finishing process is to dip the parts in the lacquer vat, permit them to drip off and then place them in the drying room, which has a temperature of 180 deg. F., where they remain from 2½ hr. to 3 hr. They are now ready to be assembled and replaced in the cars.

If the natural brass finish is desired, they are taken directly from the sulphuric acid bath and instead of pass-



Silver plating room showing vats and electrical control board

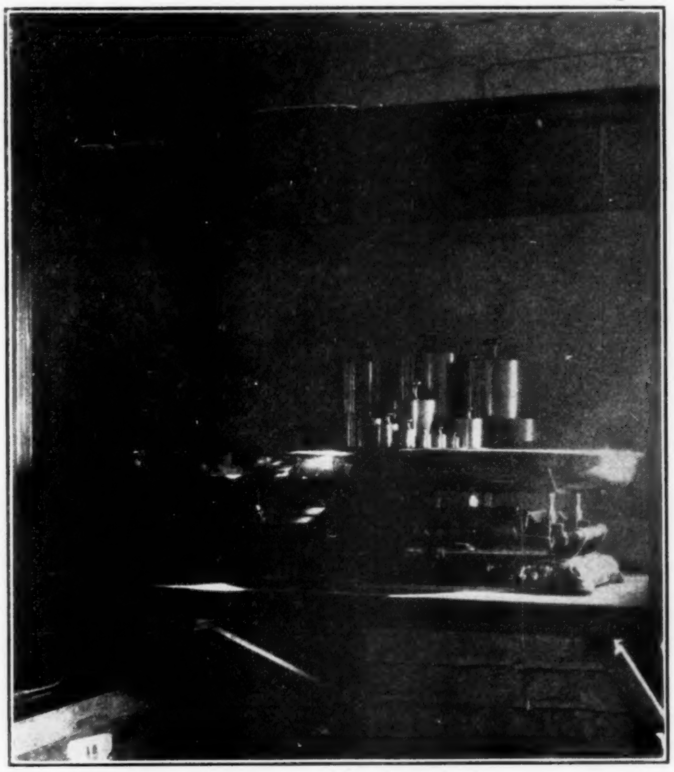
ing through the copper plating tanks, are lacquered and dried.

The requirements of copper plating

When working with solutions which are readily subjected to chemical reactions, the workman in charge must know his work and be constantly on the alert or otherwise he is liable to be responsible for expensive mistakes. It is not uncommon for the solutions to become sluggish so that they will not give uniform results even when several agents are added to increase their activity. This trouble can best be remedied by reducing the solution at least one-third with water and then adding small quantities of sodium cyanide, which will generally bring the solution back to normal again. The solution which has been removed may be heated to 180 or 200 deg. F., and metal cyanide added to increase the metal content. This may then be used as a stock solution for replenishing.

At irregular intervals the copper baths begin to give trouble. The first measure in trying to overcome this is to add common alum in the proportion of one or two ounces to the gallon. If this does not overcome the trouble, the bath needs more metal. Reduce the bath somewhat with water and then add as much sulphate of copper as the bath will absorb over night. This can readily be accomplished by suspending the copper salt in the usual acid dipping baskets made from earthenware or aluminum, upon the negative or work poles.

It is often found that when plating cast iron that the copper deposit peels or is not clear. One or two ounces of bicarbonate of soda or one or two ounces of bisulphite of soda should be added to each gallon of solution. This



Assay scales used to weigh silver bars and parts to be silver-plated

acts as a conducting salt and forms a sulphite in the solution, which is readily soluble in the cyanide. It produces a softer deposit and cleaner anodes.

The electric current must be carefully watched during the plating process. Too much current will blacken the work and not enough will give it a muddy appearance. If the process is pushed, the result will be a batch of spoiled work. On the other hand, if the parts are left in the bath too long, they will blister and peel. In this connection, it is essential that the hydrometer reading of the copper bath be maintained at 18½. When below this figure, 2 oz. of copper carbonate and 12 oz. of potassium cyanide should be added to every gallon of bath solution. If the hydrometer reads too high, reduce the solution by adding water.

Nickel plating cast iron parts

The most essential point when nickel plating cast iron is to have the parts thoroughly cleaned. The object of this

is to prevent blistering and peeling. The work is first polished with fine emery on a felt wheel, which removes all dirt, grease and old nickel. After this, the work is brushed off by a rapidly revolving wire brush. It is then washed off in caustic soda and rinsed in clean water and then scoured by hand with pumice stone and again thoroughly rinsed. The cast iron parts are now ready for copper plating. They are allowed to remain in the copper bath previously described for 40 min. When taken from this bath they are polished on a cotton buffing wheel and again run through the same cleaning process as described above. They are now ready for the nickel bath.

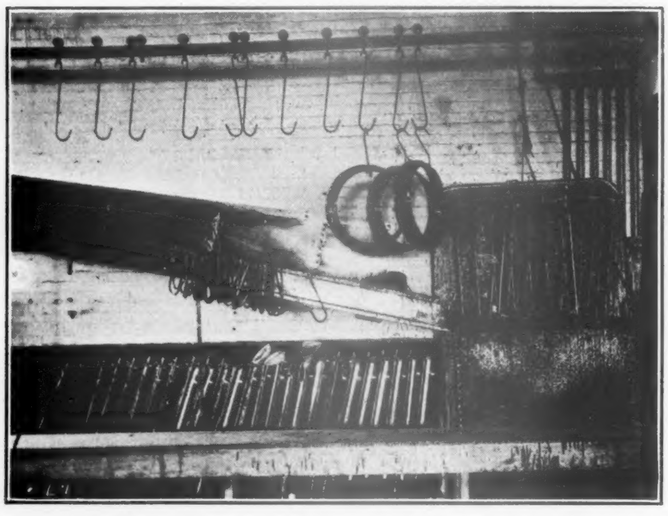
The nickel bath most commonly used for plating cast iron or steel is made up of the following ingredients:

Water	1 gal.
Single nickel salts	10 oz.
Nickel chloride	2 oz.
Boracic acid	2 oz.
Sal ammoniac	1 oz.
Epsom salts	1 oz.

This solution should give a hydrometer test of from 5½ to 7. If it is weak, it should be rebuilt with double nickel salts and water, and if strong, reduced with water. The work is allowed to remain in this bath for three hours after which it is rinsed in clean water and polished on a cotton buffing wheel.

Suggestions for nickel plating

Sometimes a nickel deposit will stain very readily. This denotes that the solution is radically alkaline. Boracic acid is commonly used for acidulating nickel baths, but for many baths, chemically pure sulphuric acid serves the same purpose at a very much cheaper cost. At the end of the day's work, to every hundred gallons of bath add 10 oz. of the acid dissolved in water and stir thoroughly. Hydrofluoric or hydrochloric acid may also be added upon the same ratio with excellent results. In the morning it will

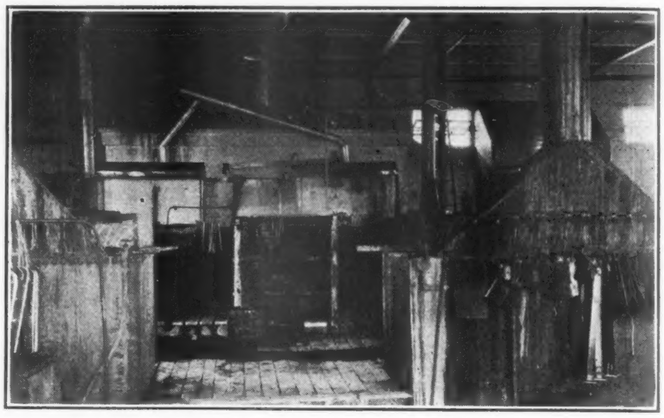


Paint vat in lacquer room, used for painting headlight casings, car gates, etc.

be found that the solution will have cleared and the staining will be overcome.

Stains are sometimes produced on nickel deposits by contaminated rinsing waters, or by drying out in sawdust that has become sour. One of the best aids to drying out nickel or any other deposit and to prevent stains is the old-fashioned plater's compound, called whale oil soap. Two ounces of this material dissolved in each gallon of boiling water will act as a dryer. The water will completely run away from the surface of the articles, thus saving labor and much sawdust.

The pitting of nickel deposits is usually caused by a deficiency of metal in the solution, or too much free acid; either case produces an excess of hydrogen gas upon the articles which appears to burn into the surface of the deposited nickel, producing pitting. The remedy is to add 2 or 3 oz. of nickel sulphate to the gallon if caused by a deficiency of metal. If caused by too much free acid, add carbonate of nickel; this is best added in the plastic form. Plastic carbonate of nickel is produced in the same manner as plastic carbonate of copper from copper sulphate, by adding two pounds of carbonate of soda to each pound of sulphate of nickel dissolved in boiling water. After precipitation, filter carefully and rewash several times with hot water. One-half to one ounce of plastic nickel car-



View showing acid vats and drying room in the rear

bonate per gallon of solution will usually overcome the free acid in a nickel bath. Nickel chloride and also nickel fluoride have been found to be excellent factors in reducing pitting. The chlorine, liberated combines with the hydrogen and is reduced to acid. A half ounce or more should be added per gallon of solution.

The peeling of nickel deposits is not always due to imperfect cleaning, imperfect removal of oxides, free acid, or free alkali in solution, but to a lack of a conducting salt. This can be remedied by the addition of common salt, salammoniac, sulphate of ammonia, epson salts or nickel chloride. When the conductivity of a nickel solution is poor, dark lines will be found covered by the supporting wires or frame. A stronger current applied will not make matters any better. A conducting salt is needed, one or two ounces of which, added to each gallon of solution, will overcome this difficulty. Nickel solutions very seldom need a conducting salt; when once prepared, they do not decompose very readily, remaining quite constant. Some anodes are very hard, especially those cast in chilled moulds, and they do not reduce readily; any disturbance then noted would be due to a lack of metal in the solution, unless the bath had become contaminated with some foreign substance.

When nickel solutions are in a good working condition it is easy to maintain them even when worked constantly during the day. The amount of nickel deposited is not entirely replaced by the anodes even when as much anode surface is exposed to the action of the bath as can be conveniently placed upon the supporting rods.

Equipment for silver plating

Locomotive headlight reflectors are the important items which are silver plated at this shop. Those needing refinishing are collected until a batch of 40 or 50 are ready for renovation. This is done because it is not economical to silver plate a few items at a time. The silver plating is done by the foreman in charge of the department, who is

held responsible for each ounce of silver in his possession, and therefore, keeps a close check on the consumption of the silver and the cost of plating.

The silver plating tubs, scales for weighing the silver anodes, distilling equipment which furnishes distilled water for the Boston & Maine System, and the safe, in which the silver bars are kept are enclosed in a heavy steel wire cage which is always kept locked when not in use. The wooden tub for silver plating will hold 180 gal. of bath and, when not in use, is covered over with a canvas hood to keep out foreign matter. The bath and parts being plated are agitated by means of a rod which is attached to the cathode or rod on which the work is suspended. This rod is rocked back and forth by means of a ¼-hp. motor. The object of this idea is to keep in constant contact with the work, a part of the solution that is saturated with silver deposits so as to obtain a uniform coating of silver on the reflectors.

The following is the formula used when preparing a bath for silver plating:

Water	1 gal.
Sodium cyanide	7 oz.
Silver chloride	4 oz.
Ammonium chloride	½ oz.

This bath is maintained to give a hydrometer reading of 18½. If it becomes weak it is built up by adding sodium cyanide and silver chloride and if too strong is diluted with distilled water. The silver bars which serve as the anodes are carefully weighed before and after using. This determines the amount of silver used. The current used is 160 amp. and from 6 to 8 volts. The general idea of the arrangement of the silver plating room can be obtained from the illustrations accompanying this article.

Silver plating headlight reflectors

Parts to be silver plated are cleaned with greater care than in the processes already described. This is essential, when silver plating, in order to prevent blistering or peeling. The parts are first cleaned in hot caustic soda which removes loose dirt and grease. They are then dried and buffed on a cotton wheel, after which they are stenciled serially on the inside from one up. This is done for weighing purposes in order to determine the amount of silver deposited on each reflector. To prevent the backs of the reflectors from being plated, they are lacquered. They are next given a bright copper finish by polishing on a cotton buffing wheel using Acme white finishing compound. They are again washed off with hot caustic soda, rinsed with hot water, and then cleaned by hand with pumice stone. They are next immersed for five minutes in a mercury bath which provides a base for the silver to adhere to. This bath is made up of cyanide of potassium, a mercury and distilled water. The reflectors are again cleaned with pumice stone and a hand brush and rinsed off in hot water. Each reflector is now carefully weighed and placed on the cathode rod of the silver bath. It remains here about 25 min. during which time approximately .75 ounces of silver is deposited on each reflector. When the plating process is finished the reflectors are allowed to drain off. They are then rinsed in distilled water and dried with compressed air. They are again weighed and then given the final finish by polishing with rouge.

The table shows the cost of silver plating 44 reflectors. Labor and material required for 44 reflectors:

Labor charges

Buffing,—	18 hr. 48 min., @ 66c an hour	$12.41
Plating,—	20 hr. 24 min., @ 73c an hour	14.89
Total	**39 hr. 12 min.**	**$27.30**

Material charges

Tripoli, 4 lb., @ 12½c a lb	$0.50
Lacquer, 1 qt., @ $1.00 a qt	1.00
Acme white, 3 lb., @ 23c a lb	.69
Rouge, 1 lb., @ 43c a lb	.43
Buffing wheel, 5 sections @ 45c a sec	2.25
Silver, 30.17 oz., @85c an oz	25.64*
Total Material	$30.51
Total Labor	27.30
Total cost of plating 44 reflectors	$57.81
Cost of each reflector	1.31

*Weight of anodes before plating	355.94 oz.
Weight of anodes after plating	325.77 oz.
Amount of silver used	30.17 oz.

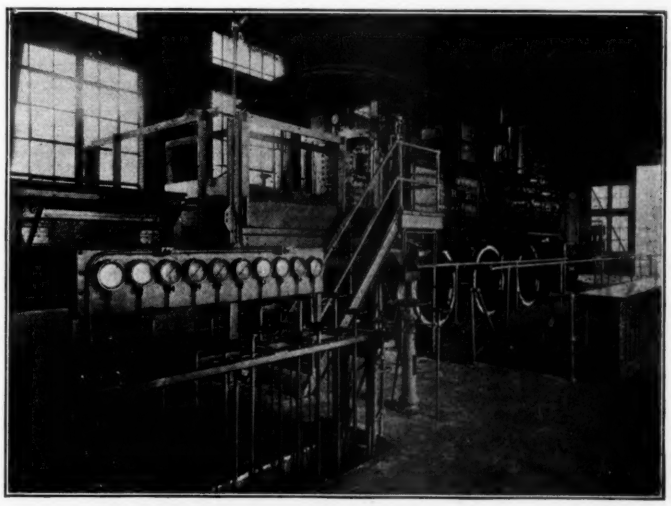
Suggestions for silver plating

Care must be taken when preparing a new silver bath not to add too much free cyanide to it as it is much better to have an excess of undissolved silver salts in the bottom of the tank than an excess of cyanide. A new bath is sometimes very erratic. A little water of ammonia added to a new bath helps to age it, and a little ammonia added when the anodes have a tendency to turn dark or black will be found of value. If too much cyanide has been added to the bath at any time, add a little nitrate of silver, one-quarter ounce to a gallon. This will be found better practice than trying to take up the free cyanide with chloride or cyanide of silver.

In freshly prepared silver baths the silver deposit is sometimes dark and granular, and because of the low voltage the anodes do not readily yield up their metal. If small amounts of ammonium chloride or potassium carbonate do not correct the trouble then it is advisable to increase the internal resistance by adding very small portions of a brightening colloid.

Other parts renovated

Various other miscellaneous parts are repaired in this department. Car locks and lamps are repaired and refinished. Headlight casings, car gates and brake levers are painted by the dipping process. These parts are brought to the shop repaired. They are then cleaned in caustic soda thoroughly dried after which they are then dipped in the paint vats, allowed to drip and then placed in the drying room for four hours. One of the illustrations shows the paint vats with headlight casings hanging on hooks suspended from the monorail. This shop can completely renovate the trimmings of four cars each day.



Interior view of the locomotive testing laboratory at the University of Illinois

Improving car department service*

Methods used by the "Milwaukee" for reporting bad order cars and repairs—Problems of personnel

By L. K. Sillcox

General superintendent of motive power, Chicago, Milwaukee & St. Paul, Chicago.

Part II

WORK coming under A. R. A. rules is of such large proportions that the importance of systematizing and organizing the work is very apparent to all concerned. In the past, much of the billing work consisting of transcribing records of various kinds on to the A. R. A. billing card, resulted in mistakes and misinterpretations because the transcribing was usually done by clerks who did not understand the work. At the larger points where many men are engaged and much foreign line work is done, it is possible to reduce the transcribing very materially by using the A. R. A. billing repair card as the original record, having it filled in by the car man or checked at the work and forwarding it to the central billing office for the usual collection. It is necessary to have what is termed the original record, which is to be filed at the point where the work was done and it is considered that this requirement is met by keeping a carbon copy of the A. R. A. billing card at the local points for this purpose.

The method of recording material applied to freight cars differs greatly on the various railroads. Some charge material used from the slips made for drawing material, whereas others charge out the material from records of work done on the car. In the case of foreign car repairs it is possible to use the billing repair card when material is charged out as applied instead of as drawn in case the latter method is used.

The education of inspectors, checkers, repair men, etc., employed in handling foreign line repairs, should be followed closely and traveling inspectors are found to be of very great importance in the proper handling of this work. Periodical bulletins should be issued from time to time showing recent interpretations of rules and also giving answers to all questions submitted to a central office by inspectors.

The practice of following up the bad order car situation is now practically the same throughout the country, the

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Form 55

CHICAGO, MILWAUKEE & ST. PAUL RAILWAY COMPANY

TO PUGET SOUND—ELECTRIFIED

CAR DEPARTMENT

DAILY TELEGRAPHIC REPORT OF BAD ORDER CARS ON HAND AND REPAIRED AT 6:00 P. M.

FILED 1:49 a.m. LOCATION General Shops November 22nd 1924

NO. OF SYSTEM CARS LOADED AND EMPTY

LOCATION	Box On Hand A	Box Repaired Since Last Report B	Furniture and Carriage On Hand C	Furniture and Carriage Repaired Since Last Report D	Automobile On Hand F	Automobile Repaired Since Last Report G	Refrigerator On Hand J	Refrigerator Repaired Since Last Report K	Vegetable and Beer On Hand M	Vegetable and Beer Repaired Since Last Report N	Stock Single Deck On Hand O	Stock Single Deck Repaired Since Last Report R	Stock Double Deck On Hand U	Stock Double Deck Repaired Since Last Report W	Flat On Hand X	Flat Repaired Since Last Report AB	Coal On Hand AC	Coal Repaired Since Last Report AD
Repair Track	75	20			14	4	1				17	1			32		19	2
Belt	39				1										5		74	
TOTAL	114	20			15	4	1				17	1			37		93	2

LOCATION	Ore On Hand AF	Ore Repaired Since Last Report AG	Caboose On Hand AJ	Caboose Repaired Since Last Report AK	Work and Miscellaneous On Hand AM	Work and Miscellaneous Repaired Since Last Report AN	Special Equipment On Hand AQ	Special Equipment Repaired Since Last Report AR	Foreign Tank Cars On Hand AS	Foreign Tank Cars Repaired Since Last Report AU	Foreign Other Than Tank and Special Equipment On Hand AY	Foreign Other Than Tank and Special Equipment Repaired Since Last Report AX	Totals Loaded On Hand BA	Totals Empty On Hand BC	Totals Loaded Repaired Since Last Report BD	Totals Empty Repaired Since Last Report BF
Repair Track	7		11		2		1		1	1	11			191	2	26
Belt														119		
TOTAL	7		11		2		1		1	1	11			310	2	26

WIRE THIS PORTION

LOCATION	Class of Repairs Required Cars on Hand: Running On Hand CA	Light On Hand CB	Medium On Hand CD	Heavy On Hand CF	Rebuilt On Hand CG	Total On Hand CH	Class of Repairs Made Since Last Report: Running Repaired Since Last Report DA	Light Repaired Since Last Report DB	Medium Repaired Since Last Report DC	Heavy Repaired Since Last Report DF	Rebuilt Repaired Since Last Report DG	Total Repaired Since Last Report DH	Number of Men Working MN	Number of Men Absent MO	Weather Conditions MR
Repair Track				3	188	191	3	1			24	28	300	25	Cloudy
Belt				21	98	119									Cloudy
TOTAL				24	286	310	3	1			24	28	300	25	

THIS INFORMATION WILL BE SHOWN ON SATURDAY'S REPORT CLASS OF REPAIRS REQUIRED AND NO. OF DAYS ON HAND

LOCATION	Running 2 Days or Less FA	Running 3 to 5 Days FB	Running 6 Days and Over FC	Light 2 Days or Less FD	Light 3 to 6 Days FG	Light 6 Days and Over FJ	Medium 5 Days or Less FK	Medium 6 to 15 Days FM	Medium 16 Days and Over FN	Heavy 5 Days or Less FO	Heavy 6 to 15 Days FQ	Heavy 16 Days and Over FR	Rebuilt 10 Days or Less FS	Rebuilt 11 to 30 Days FW	Rebuilt 30 Days and Over FY	Total On Hand FX	Safety Appliances System Cars On Hand to be Equipped SA	Safety Appliances System Cars Equipped Last Week SB
Repair Track										1		2	105	59	24	191		
Belt												21	6	70	22	119		
TOTAL										1		23	111	129	46	310		

WIRE THIS PORTION

INDIVIDUAL CAR NUMBER (SYSTEM ONLY) GIVEN. REBUILT HEAVY AND MEDIUM REPAIRS

Rebuilt—Class A			Heavy—Class B				Medium—Class C			
82740	504809	502553								
89526	500299	502896								
82264	500616	502351								
204876	502671	502565								
500744	501059	590131								
203182	591262	91352								
90638	709244	500726								
92126	590151									

DO NOT WIRE THIS PORTION

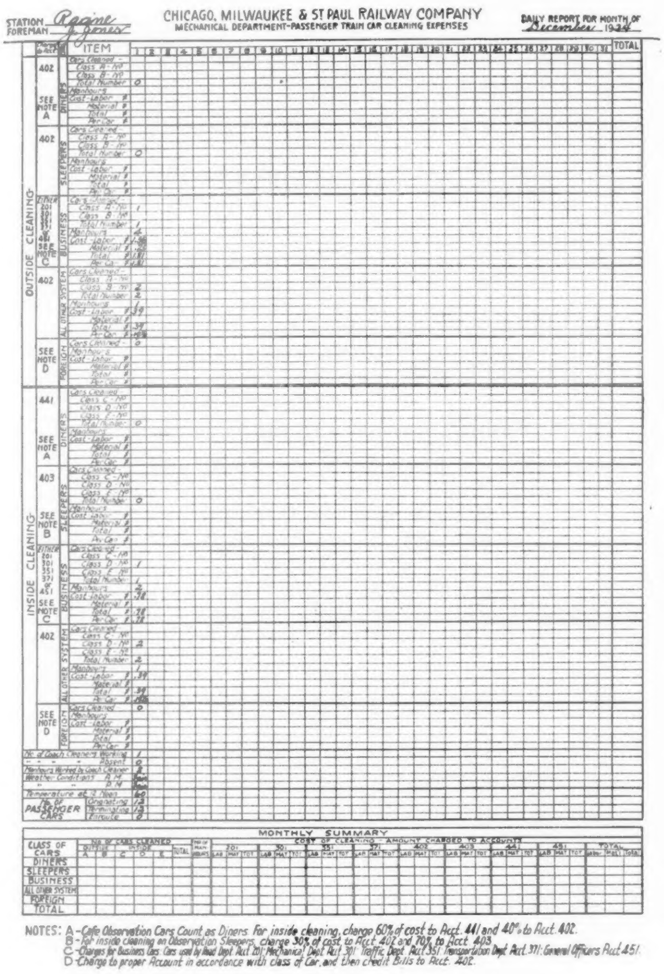
NOTE:—This report should be made out daily, except Sundays and holidays as hereinafter provided for, by foreman of each car repair station and given to Agent who will telegraph all except lower portion to C. G. JUNEAU Master Car Builder, Milwaukee Shops, each evening, and then forward the report by mail, enclosing same in envelope, Form 1518. Cars repaired and number of men working on Sundays and following holidays: New Years, Washington's Birthday, Memorial Day, July 4th, Labor Day, Thanksgiving Day and Christmas, are to be included in the report for the following day.

Signed J. Smith Foreman in Charge

Daily telegraphic report of bad order cars on hand and repaired at 6 P. M.

* The conclusion of an abstract of a paper read at the regular monthly meeting of the Car Foremen's Association of Chicago, held December 8, at the Great Northern Hotel, Chicago. The first part of this paper appeared in the January *Railway Mechanical Engineer.*

difference being only as to the matter of form and application of the data. This involves the question of classification and organization to handle the work and control the bad order situation. For the purpose of simplifying the matter, repair points can be classified, each having a stated output requirement based on the classes of heavy and light repair work handled. On the Chicago, Milwaukee & St. Paul, Class one repair points are those having 100 men or more with facilities to handle heavy and schedule work at a specified maximum output; Class two repair points are those with facilities for doing some heavy work, having no less than 15 repair men engaged in this work; Class three repair points are those having some facilities



Report of passenger car cleaning expenses

and less than 15 men engaged in repair work; Class four repair points are those stations of a lighter nature not included in the above.

Bad order car report

A sample of the daily bad order freight car repair report is illustrated which shows by kinds of cars the repairs made each day and the bad order cars left on hand together with the number of men engaged on car repair work, etc. This is a daily report which is sent to the central office for consolidation. In addition to the daily report a special statement is made once each month showing all bad order cars on hand at the end of the month by individual car numbers, initials, date bad ordered, principal defects and date expected out. The purpose of this form is to determine unnecessary or unusual delays to individual cars and to select those which have been held 30 days or more to see what can be done to overcome such delays. This report is of great value in following up per diem losses and the releasing of cars in time of shortage.

We use the blank back of the daily bad order report for special information and one of the features is a report of personal injuries occurring each day. Personal injuries are followed up closely and recorded in relation to the turnover of labor to see whether it is due to new employees or lack of safety measures, methods of handling work, etc. It is felt that in following up such matters the local foremen are placed in a position where they must naturally assume more responsibility along this line and keep injuries down to a minimum.

We also have shown on the back of this report a statement of material shortage confined to that which is handicapping the work. This shows the requisition number, the date ordered, the follow ups, etc., with a view to assisting the general officers in overcoming the situation.

A car department hand book is issued from time to time designed to embrace practically all of the activities in the handling of car work which come up from day to day and which are more or less standard.

Passenger car cleaning

In the matter of cleaning passenger cars, it is natural to suppose that this is a subject of a minor nature requiring no special records or supervision, but owing to the fact that the Chicago, Milwaukee & St. Paul owns and operates sleeping cars this requires a definite division of the cost as between departments and we have felt it necessary to go into this feature rather closely. The cost of cleaning passenger cars is charged to three different accounts, except business cars, which may go to many different accounts. The outside cleaning of all cars (except business cars) and the inside cleaning of all but sleepers, diners and business cars, is chargeable to account 402. The inside cleaning of sleepers is chargeable to account 403 and the inside cleaning of diners is chargeable to account 441. The cost of cleaning special or officers' cars should be lodged against the superintendence account according to use. This is a rather complicated procedure and as the direct cost of this work is combined with a multitude of other kinds of charges it is not possible to control the expense without dividing these accounts and determining the direct labor and material charges and the amounts allocated in spreading the overhead charges. It is possible to analyze actual individual train operation to control this expense by means of direct labor cost, but this is not always available as the information is based on a variety of data, which is not the same at all times and a mere control of the direct labor feature does not give any idea of the correctness of other allocated charges.

In order to follow up the cleaning cost properly it is necessary to have organization and classification. We are handling it as outlined on the report form illustrated, which is based on inside and outside cleaning and classification of equipment according to the division in the accounts. We have divided the classes of cleaning into the following:

(A) Outside cleaning when car is scrubbed with water and acid and trucks sprayed with distillate oil.
(B) Outside cleaning when car is scrubbed with water only and trucks cleaned with or without oil spray.
(C) Inside cleaning when car is sponged with soap and water and otherwise renovated.
(D) Inside cleaning when car is blown out, swept, dusted and mopped.
(E) Light cleaning of inside en route at intermediate stations.

The classification of cars for making the proper division of the cleaning cost to the appropriate accounts is as follows:

(1) Diners and cafe-observation cars.
(2) Sleeping, tourist, compartment sleepers and observation sleepers.
(3) Business cars.
(4) All other passenger train cars.

The instructions provide that cafe-observation cars

count as diners and that the inside cleaning cost shall be divided so that 60 per cent goes to account 441 and 40 per cent to account 402, this being based on average dimensions. A division of the charges for inside cleaning of observation sleepers provides for 30 per cent against account 402 and 70 per cent against 403. Charges for business cars depend upon the account of superintendence to which the officers' pay is charged. Charges for all other work on ordinary cars go to account 402.

It might appear that this form is too much in detail, but it is as yet an experiment and is lined up something in the same manner as we handle enginehouse expense. It is possible to make an entry of all operations each day in the month and then to use the same form for a monthly summary of the system. The summary at once gives us the total charge against the various accounts for cleaning cars and when the difference between the direct charge and the total charge as made by the accountant is too great, a further analysis is made to determine the reason. This form covers both labor and material, but does not provide for the usual overheads allocated by the accountant, such as store expense, shop expense, power plant distribution, bills, vouchers, etc. This is merely another illustration of intensive supervision of a certain class of work which cannot be fully controlled by other means.

Hiring men

The personnel, comprising labor forces, reflects the intelligence exemplified by the employing officer when selecting new men for the service. In some cases there are periods where he may be restricted from making his judgment effective in the selection of his men, such as we witnessed during the late war when the labor shortage was tremendous and we were compelled, in many instances, to accept men who, under ordinary circumstances, would not meet the requirements. There are other times such as when forces are to be increased immediately for emergency service. This causes the average foreman to overlook the importance of knowing what kind of a man he is hiring. In every instance, where conditions will permit, the objective should be to secure the best available talent. The management must always have this thought in mind when issuing instructions to increase forces. Much can be accomplished, where large numbers of men are employed, by arranging for permanent forces, which results in steady employment to a sufficient number of men to take care of the service adequately. Emergency cases and fluctuations in business can be taken care of by temporary forces, and, if hired as such, it will give the employing officer an opportunity of selecting the best material to be assigned to the regular forces when vacancies occur.

Advancement of men

Proper care having been taken in selecting men for the service, it then becomes important that they receive the right training so as to develop whatever natural qualifications they may have for future advancement. Car foremen who are alert will quickly discover these traits and will endeavor to perfect their development, resulting in highly competent men being available for positions that require special skill or unusual attention on the part of the workmen. Such men should gradually be worked into the organization in the various positions for which their natural qualifications adapt them.

The great need in industry today is to provide employment that has an incentive for the employee voluntarily to do his utmost instead of being merely on the job. In many instances large employers have, at very heavy expense, provided departments to carry out well planned activities of interest to the welfare of their employees and often the results have proved a good investment. These plans are adaptable where the points of employment are confined to comparatively small territory. On railroads, employment is maintained every hour in the day, each day in the year, over thousands of miles, covering in many instances several states, making it practically impossible to follow such a plan, even though it were adapted to the needs. Therefore, of necessity, use should be made of other methods so that the average man will aspire to do his utmost in the interest of the service. To bring this about, it has been suggested that the following outline be striven for: (1) steady employment; (2) clean and sanitary housing conditions; (3) educational facilities; (4) a correct and complete understanding of company objectives.

The proper cultivation of human relations is equally important and mutually desirable in providing an incentive for employees to advance in the service. Every officer should feel that he really exemplifies the spirit in which the management is to be accepted by the rank and file. The foreman, in this connection, by his every act, reflects the policy and desires of the management, and, if they are cordially and humanly applied, it will establish

O 8 22 7M Form 870

Chicago, Milwaukee & St. Paul Railway Co.

TO PUGET SOUND—ELECTRIFIED—

CAR DEPARTMENT

Station .... Date ....

Car Foreman ....

List of Bad Order Cars on Hand at this Station this Date

CAR NO.	KIND	INITIALS	Date Marked Bad Order	Loaded or Empty	Contents and Location	DEFECTS	[illegible]

NOTE:—Use Symbol "L" to indicate Loaded, and Symbol "E" to indicate Empty. This Report should include cars actually on Repair Track, or in yards awaiting to go on Repair track. "Contents and Destination" column to be filled in only for Loaded Cars. This Report to be made up on the last day of each month and forwarded to the Local Operating Official in charge of Switching, carbon copy to be forwarded to the Master Car Builder, Milwaukee Shops.

Monthly report of bad order cars on hand

a mutual understanding that develops conditions which instill in the hearts and minds of the men the desire to succeed.

Too often supervisors, and managements as well, lose sight of these essentials which are so eminently necessary to enlist the undivided support and loyal feeling which results in the men liking their work. Once this is accomplished, the way is cleared to perfect an organization among the men, who can function in units, that will provide successful accomplishment. Capable foremen readily acquire the ability to observe men who have this incentive and who, by their efforts, show distinct evidence of being willing and able to secure greater knowledge of the service and assume the added responsibilities involved in the discharge of the duties in each instance where men are advanced to more important positions. Men of this caliber must always be kept in mind and properly trained so that, eventually, they will be able to understand the fundamentals in connection with handling men, and, when vacancies in supervisory positions occur, they should be filled by those whose service merits such promotion. If properly handled, advancement will generally meet with the approval of the rank and file, and be further evidence that there exists an opportunity for them to do likewise, if they will fit themselves and be ready, at all times, to meet service requirements.

Discipline

The administration of discipline is in itself an act of judgment on the part of the management. No well directed property can function efficiently until the subject of discipline has been thoroughly studied and a definite

policy inaugurated, because discipline can rightfully be construed as constructive criticism. Each property has its individual problems to meet and in applying discipline to employees it should be done with a sense of justice that will be eminently apparent to those involved. Sentiment and personal favors must be entirely eliminated. Honesty, and a willingness to define the facts, should at all times prevail in order to eliminate the greatest evil in the application of discipline, which is discrimination. It is practically impossible to apply constructive discipline in any line of industry where there is a large labor turnover.

Foremen are apt to apply discipline under pressure by removing men from service for causes which when investigated are not substantiated by fact, resulting in their judgment having to be superseded by higher authority, and the employees involved returned to service. Action of this kind often causes the foreman to feel that he has not been properly supported, resulting in his becoming indifferent as to the action necessary in subsequent cases. Care should be exercised to impress each supervisor with the necessity of applying the principles above referred to in each case and profit by the judgment of his superiors because the details differ materially in almost every case where discipline should be applied. On the other hand, when cases are appealed to higher authority, decision must be rendered in support of the foreman where the facts and policy of the management warrant the action taken. Then if leniency is to be applied, the employee involved should so understand and the foreman be informed so that he will appreciate his duty when other or similar cases arise.

If these few facts in connection with discipline are truly observed and applied in harmony with existing conditions, a reduction in labor turnover will be readily evidenced. Close observers realize the tremendous expense, many times avoidable, due to the unnecessary changing of labor forces. If an employee is to be dismissed, it should be apparent that the service is thereby benefited. Very frequently employees are taken out of service and the new men assigned prove inferior, which clearly indicates that it would be an advantage to the railroad to have kept the employee in service, especially if a method could be applied that would eliminate any undesirable characteristics that he may have acquired. In this respect there is an element worthy of consideration. We appreciate, I am sure, that there are men who are objectionable and a detriment, and of course they should in some way be dealt with and definitely removed, care being taken that they do not re-enter the service at some other point without satisfying the management of their intention and desire to function so that their employment will be acceptable and of interest to the service. Discipline resolves itself into a feature of management, which must be comprehended, but never compromised.

Conclusion

In closing, allow me to suggest a few seemingly important items, as a matter of illustration, to indicate the meaning of effective car department service and which embrace:

(A) An organization with fixed ideals of attainment, working together towards the accomplishment of that end and with the right sense and exercise of the importance of individual initiative and responsibility.

(B) The proper contribution towards safe and prompt train performance by obtaining maximum mileage per car per year with a minimum of detention en route due to inspection, physical defects or damage to lading, and at a minimum cost.

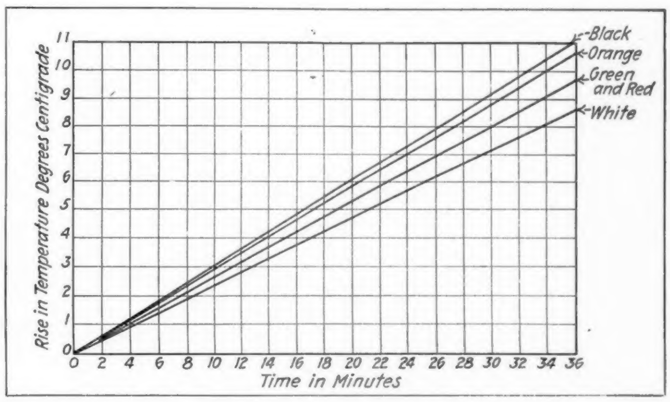
An experiment to reduce refrigeration losses

By Henry A. Gardner
Institute of Paint & Varnish Research Laboratories, Washington, D. C.

During the summer months, surfaces painted in dark colors rapidly absorb the heat rays and become very hot. When white paints are used, the painted surfaces are slow to absorb the heat rays and, consequently, will remain several degrees cooler. An application of this principle might well be made to conserve ice and keep refrigerator cars at a temperature sufficiently low to preserve the perishable foodstuffs for a longer period of time. At the pesent time refrigerator cars are generally painted an orange color which rapidly becomes warm and transfers its heat to the various compartments. The result is a loss of ice and foodstuffs. This is indicated by the results of some of the experiments recently conducted at the Paint and Varnish Research Laboratory at Washington, D. C.

Method of making tests

Experimental carriers were constructed of friction top containers. A double wall effect was obtained by placing a pint container inside of a quart container. The space



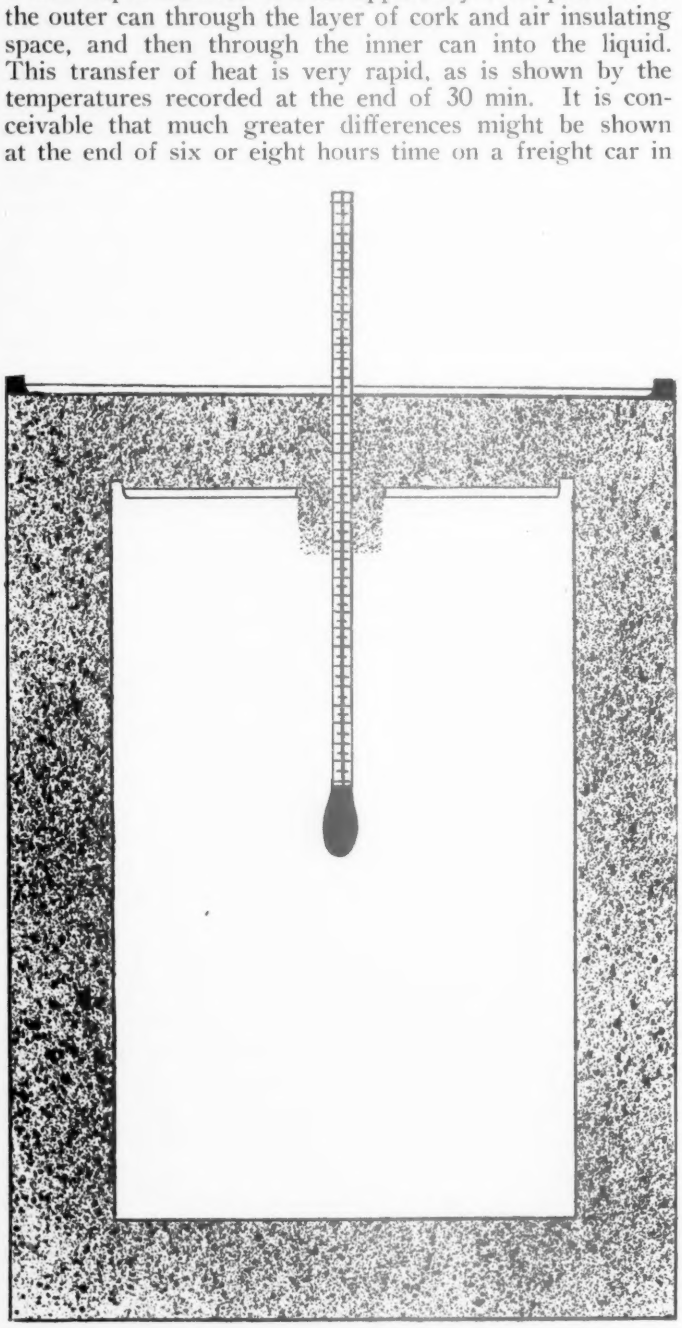
Graphic representation of the rise in temperature of different colors of paint when exposed to the sun

between was filled in with ground cork about 1/16 in. to 1/8 in. in diameter. The exterior surface of the outer container was painted two coats, each with a different color. Several containers were thus prepared and filled at the same time with a low temperature refrigerating fluid. The liquid used in one instance was ice water, and a solution of solid carbon dioxide gas in acetone was used in the other instance, which had a temperature of 40 deg. C. Closely comparable results were obtained with these two liquids. Cracked ice was also experimented with, but it was found difficult to obtain uniform temperatures in each can because of the difficulty of transferring the ice in exactly equal quantities without a loss of temperature.

After placing the liquids in the inner cans, the covers, which were provided with stoppers and thermometers, were adjusted and a layer of cork spread over the upper surface after which the outer containers were sealed at the top. The row of vari-colored containers was placed out of doors in the sun and thermometric readings were made once a minute. At the end of 30 min. the black cans could not be handled because of their high temperature of 140 deg. F. The white cans could be handled

comfortably, indicating a very much lower temperature. Later experiments with white metallic pigment powders indicated that they do not give as efficient results as the white paint, but superior results to most tinted or colored paints.

The rapid transfer of heat apparently took place from the outer can through the layer of cork and air insulating space, and then through the inner can into the liquid. This transfer of heat is very rapid, as is shown by the temperatures recorded at the end of 30 min. It is conceivable that much greater differences might be shown at the end of six or eight hours time on a freight car in



Arrangement of apparatus for determining refrigeration losses

a sunny yard or even in transit. Convection might, however, play an important part in the latter instance. The results obtained with these tests would suggest the use of white or light tints rather than the darker colors on refrigerator cars.

Through the use of test fences out in the open, the value of paint as a preservative has been proved and now through this latest experiment a new use of the right kind of paint to reduce to a minimum refrigeration losses in freight cars has been shown.

Proper application of paint

In line with this research work on the painting of refrigerator cars is the application of the paint. Where it formerly took a man at least a day to apply one coat of paint to a freight car, it now takes but an hour or two provided the principle of atomization or spraying is used. The paint gun, after much experimenting, has been brought from a crude, imperfect tool to a simple, highly effective device. Painting by this mechanical method can be done in a fraction of the time required by hand brushing, the paint is spread more uniformly, and the coating of paint, so important to the refrigeration car, is heavier and more durable.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Information to be specified in case of replaced springs

The Erie made repairs to C.S.N.O. & P. car No. 122033, which is the property of the Gulf Coast Lines. Among the items of repairs made was included the replacing of one D.C. draft spring on account of being broken. The Gulf Coast Lines returned this repair card to the Erie calling attention to the fact that the repair card did not show that both coils of the draft spring were broken and referred to the interpretation of Rule 8 as authority for request that the charge be reduced to cover the outside coil only. The Erie returned the repair card and refused to reduce the charge as requested, claiming that as the repair card and original record of repairs showed "D. C. Spring" applied on account of being broken, the charge for both coils was correct.

The Arbitration Committee rendered a decision to the effect that: "In order to justify a charge for a double coil spring, it is necessary that the original record of repairs, as well as billing repair card, show that each coil was defective. This information must not be assumed."—*Case No.* 1315, *Gulf Coast Lines vs. Erie.*

Responsibility for car damaged in loading

Buffalo & Susquehanna steel gondola No. 12258 was delivered by the Delaware, Lackawanna & Western to the South Buffalo to fill an order to load pig iron to a point on or via the D., L. & W., the order having been placed by the Rogers-Brown Iron Company with the South Buffalo. In the process of loading this car with pig iron, the body of the car buckled when partly loaded and settled down and the car body was damaged beyond repair. The owner demanded settlement under Rule 113. The South Buffalo contended, on the other hand, that Rule 120 was applicable to the case. The car owner stated that the damage to the car was originally properly reported as a responsibility of the handling line and that the facts in the case did not justify the South Buffalo in changing its report to make the case come under the Rule 120. The owner further stated that if the car had been in the condition claimed by the South Buffalo in its last report, it would not have been accepted loaded by three foreign roads and empty by the same number of roads, including the South Buffalo. It was contended that if the car was not in fit condition for loading it should have been reported, in accordance with Rule 120, by the South Buffalo, before being delivered to the shipper, in order to give the owner an opportunity to inspect the car, and not after

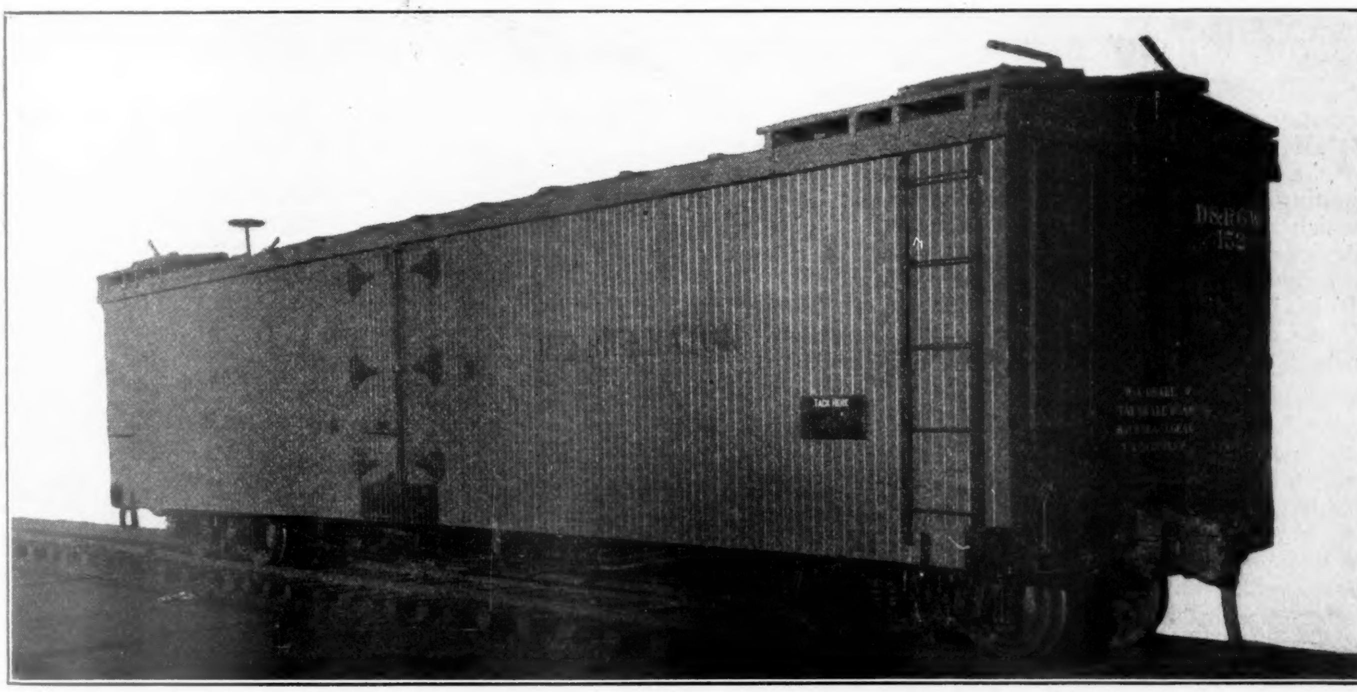
its destruction when an inspection could not possibly reveal the prior condition of the car. The South Buffalo stated that after the failure it was determined that the floor plates were so badly corroded and rusted away, and the center construction in such a weakened condition that the car was no longer fit to carry its marked capacity. It was further stated that this condition was not evident nor would it be on usual junction inspection, nor was it known to the Iron Company. The handling line contended that it must accept the owner's statement marked on the car that it will safely carry a certain load, that failure is the inevitable result of such weakness as developed in this case unless the owner takes the precaution to reduce the loading or to replace the parts which deterioration has rendered unfit for service.

The Arbitration Committee, in a decision rendered February 15, 1924, sustained the contentions of the South Buffalo in that this car was properly subject for disposition under Rule 120.—*Case No. 1317, Buffalo & Susquehanna vs. South Buffalo.*

Narrow gage refrigerator cars for the D. & R. G. W.

TWELVE narrow gage refrigerator cars were built at the Alamosa shops of the Denver & Rio Grande Western in September, 1924, with the object of making them large enough to take a minimum standard gage car load, as most of the produce shipped on the narrow gage has to be transferred to standard gage cars to reach its destination. The trucks on these cars are placed 4 ft. 3 in. from the ends, on account of the numerous sharp curves.

The cars are of wood construction throughout and weigh 34,300 lb. with a capacity of 50,000 lb. The underframe is made up of 5-in. by 9-in. side sills, two 4-in. by 8 3/16-in. inter sills and two 5-in. by 8 3/16-in. center sills. The body bolsters are of cast steel. The walls consist of an inside lining 13/16 in. thick, one layer of 90-lb. paper, 1/2 in. Flaxlinum, 2 5/16 in. air space, 1/2 in. Flaxlinum, one layer of 90-lb. paper and 13/16 in. siding. On account of the height of the car, the construction embodies only one belt rail.



Narrow gage refrigerator car which will take minimum standard gage car load

The floor is made up of a 13/16-in. sub-floor, a 1/8-in. layer of Unarco waterproofing compound, 2 in. of cork, a 1/8-in. layer of Unarco compound and a 7 3/4-in. ship lap top flooring.

The ceiling is insulated with 1 in. of Flaxlinum laid between the carlines. A Murphy XLA metal roof is used.

The doors are equipped with Ureco self-locking hinges and Miner refrigerator door fixtures. Imperial Type "B" uncoupling rigging and Economy steel ladders are applied.

The dimensions of the car are as follows:

Length between pulling faces of couplers	42 ft. 10 1/2 in.
Length over end sills	40 ft. 0 in.
Width of car, outside	8 ft. 5/8 in.
Inside length between bulkheads	33 ft. 2 in.
Inside width	7 ft. 2 1/4 in.
Inside height	6 ft. 4 in.

The bulkheads are stationary and insulated with 1 in. Flaxlinum. Tyler bunker netting is used in the ice bunkers. The bulkheads, bunkers, hatch covers, plugs and platforms follow the design of the U. S. standard cars.

Ratchet wrench for passenger car truss rods

IN the process of tightening up passenger car truss rods it is not unusual to find that battery boxes, air reservoirs and other equipment interferes with the free use of the ordinary pin bar used for this work. There is in use at the Billerica shops of the Boston & Maine a ratchet wrench which can be readily used where the space is limited.

With a wrench of this kind the buckle can be turned completely around with only a 6-in. space to turn the wrench. The stub end of the wrench is inserted in the buckle and is prevented from slipping out by a cotter key placed in a hole at the end of the stub. The ratchet may be set at a different angle as the buckle is turned around.

There can be slipped over the purposely short, 1-in. diameter lever end of the wrench a long piece of pipe by which a greater leverage may be obtained. This appliance can

Truss rod ratchet wrench adaptable for use in a limited space

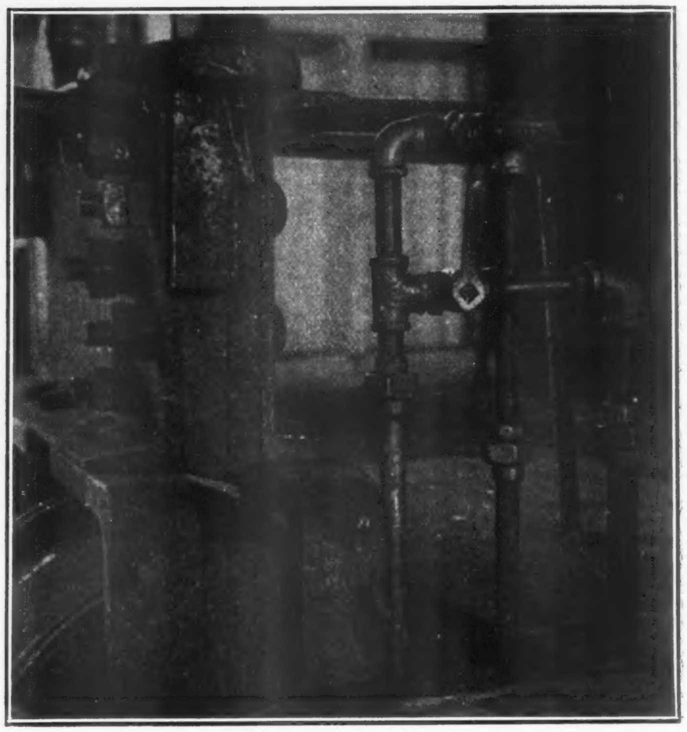
be readily made by any blacksmith and, with a small amount of machine work, there is produced a tool which will prove very valuable in tight places.

Coupler yoke riveting machine

By G. Charles Hoey

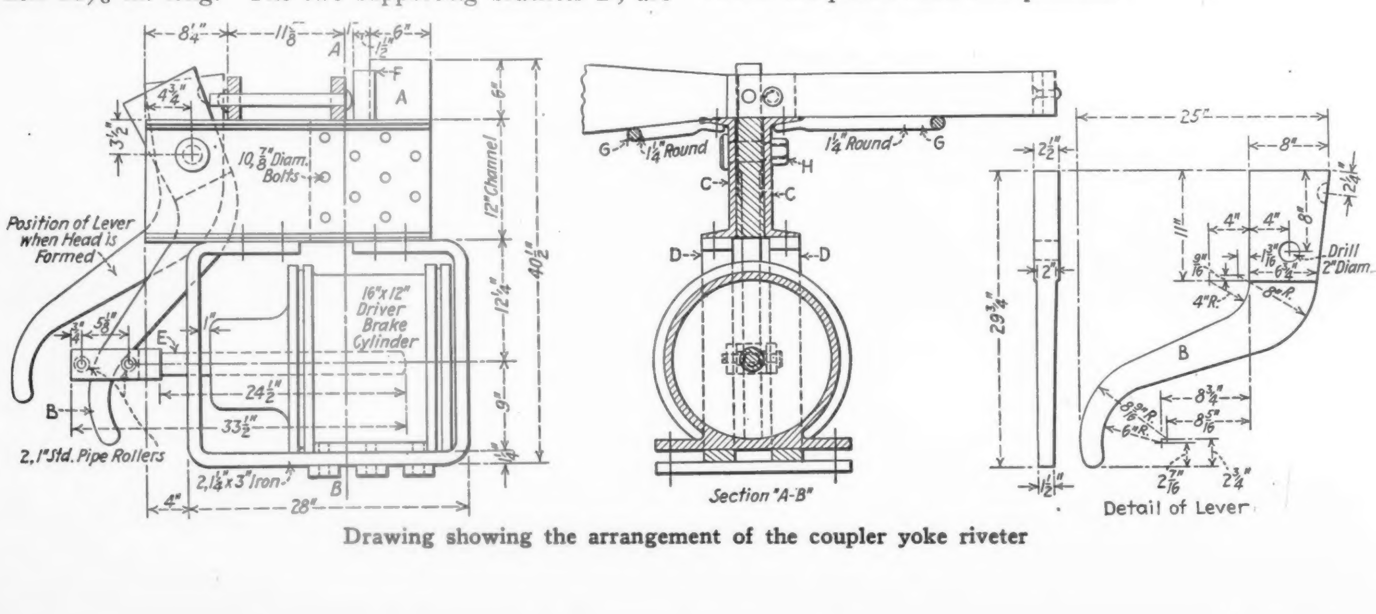
The machine shown in the drawing was devised by a car foreman in order to facilitate the work of getting cars away from the rip track, a problem which he had had considerable difficulty in solving. The device consists essentially of an anvil block *A*, a lever *B*, a supporting frame *C*, two supporting brackets *D* and a 16-in. by 12-in. driver brake cylinder. The supporting frame *C* is constructed from two 12-in. structural channels 28⅜ in. long. The two supporting brackets *D*, are formed from 1¼-in. by 3-in. bar iron. A connecting yoke *E* is welded to the driver brake cylinder push rod. Filler blocks *F*, of varying thicknesses may be inserted in front of the anvil block *A* to suit the different size coupler yokes. The supporting arms *G* are made of 1¼-in. round bar iron, and are riveted to the flanges of the frame channels.

In applying the coupler yoke to the head, the coupler butt is placed in position in the yoke on the supporting arms *G*. The heated rivet is then slipped into place and the coupler and yoke is moved over until the rivet head is in position in front of the filler block *F*. Air is then admitted to the operating cylinder and as the air cylinder

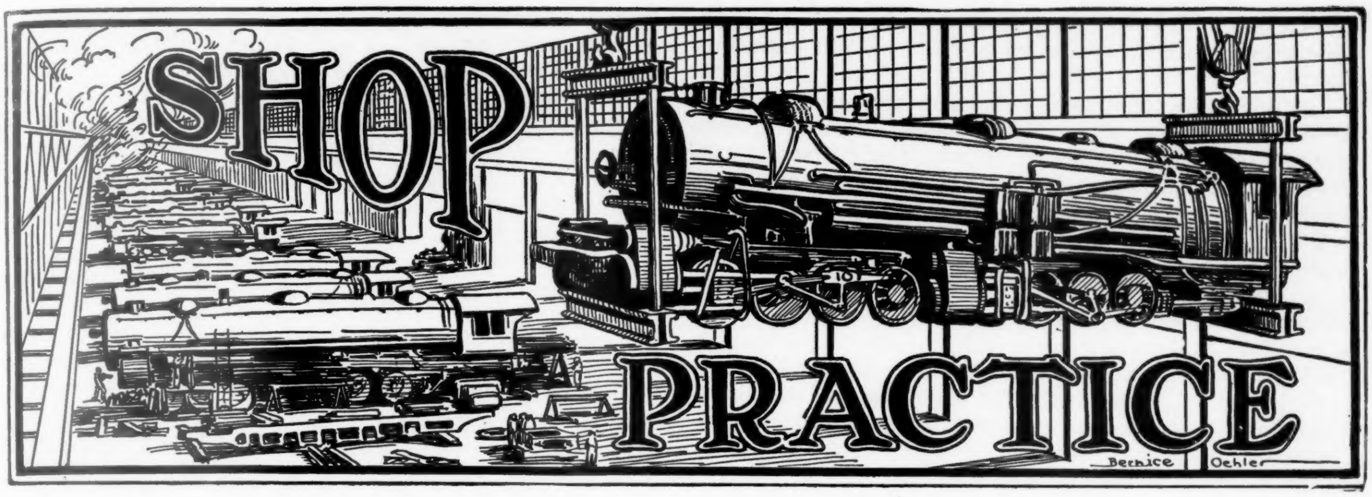


View showing the piping arrangement and location of the operating valves

piston moves forward, the back roller in the connecting rod jaw moves along the inner curve of the lever *B* which is pivoted on the pin *H*. This action of the lever drives down the protruding end of the heated rivet and the recess in the upper end of the lever *B* forms the head of the rivet. Upon releasing the air from the cylinder the spring forces the piston back into position.



Drawing showing the arrangement of the coupler yoke riveter



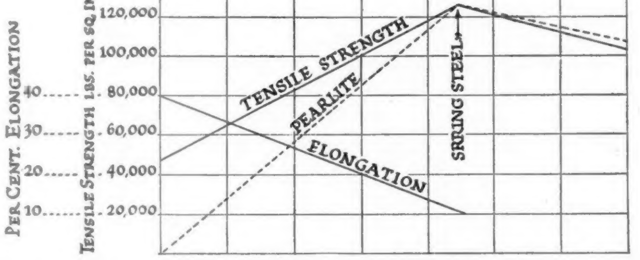
The heat treatment of spring steel

Knowledge of steel, temperature effect, quenching media and drawing or tempering essential

By J. E. Burns, Jr.
Member, research staff, E. F. Houghton & Company

MODERN heat treating should be considered as an engineering science as well as an art or trade, as it requires specific knowledge, skill and judgment for its proper performance. These in turn necessitate knowledge of steel, temperature effect on steel, quenching media and drawing or tempering factors. For, it is only with appreciation of all these factors that successful and efficient springs can be produced.

On locomotives and rolling equipment many parts are used, all having a more or less severe duty to perform and requiring steels possessing various degrees of strength, toughness, resilience, endurance, shock resisting and wearing or abrasive qualities. These various combinations of static and dynamic strength are obtained by adjusting and correlating both the chemical composition and heat treatment of the steel. Certain chemical components intensify the static, others the dynamic qualities.



Graphic presentation of the per cent elongation and tensile strength of steel with various carbon contents

Springs are subjected in service to repeated stresses. These repeated stresses upon steel cause a gradual disturbance of the structure and its component particles, which greatly weakens the material and is called fatigue. These stresses causing such fatigue can be broadly classed as repeated static and acceleration stresses, and it is necessary that a knowledge of the capacity of the steel best able to resist such action should be used and should serve as a basis for its selection.

A steel of the following constituents best meets these requirements (commercial alloys will not be discussed here as their use is not general in railroad work):

Carbon	.90 to 1.05 per cent
Manganese	.25 to 0.50 per cent
Phosphorus	.04 per cent max.
Sulphur	.05 per cent max.
Silicon	.04 per cent max.

Structure of steel

Carbon steel is an alloy, but should not be confused with the term commercial alloys that are now available. Its principal and essential chemical constituents are carbon and iron. With these are usually certain impurities such as phosphorus, sulphur, silicon and manganese.

Of the elements or constituents which go to make up ordinary carbon steels, the impurities manganese, phosphorus, sulphur and silicon approximate one per cent. The carbon will vary from a few hundredths of one per cent to about two per cent and the balance will be iron.

Steel is not a single substance like copper or gold, but is made up of mineral grains, corresponding to the quartz, mica and feldspar of granite. In steels which have cooled slowly from a high temperature, we have ferrite (iron), cementite (carbon) and pearlite (carbon and iron). And just as the relative amounts of quartz, mica and feldspar may vary in the rocks of granite so will the relative proportion of ferrite, cementite and pearlite vary in different steels according to their specific chemical composition.

In steel cooled from high temperatures the carbon is always combined with a definite amount of iron, forming a carbide of iron. This compound consists of 6.6 per

cent carbon and 93.4 per cent iron, and is microscopically known as Cementite. The balance is iron and known as Ferrite.

Cooling at a moderate rate from a red heat, this cementite will form a mechanical mixture with a definite amount of ferrite, the result of which will approximate .9 per cent of carbon and is called Pearlite. Pearlite is regarded as a separate and distinct constituent of steel, as it forms distinct grains, when present in any appreciable quantity, and always contains this definite amount of carbon.

From this it will be seen that a steel containing .9 per cent carbon will consist entirely of pearlite. Such steels are known as eutectoid steels and that ratio of carbon as the eutectoid ratio. In other words, this is the same character of steel as used in the manufacture of both elliptic and coil type springs.

Ferrite is soft, ductile and relatively weak. It has a tensile strength of approximately 40,000 to 50,000 lb. per sq. in., and has no hardening power, as applicable to industry. It is magnetic and has a high electric conductivity.

Pearlite has a tensile strength of approximately 125,000 to 130,000 lb. per sq. in. with elongation of about 10 per cent in 2 in.

The properties of cementite are very little known with the exception of its great hardness and brittleness; it probably does not have a tensile strength over 5,000 lb. per sq. in.

Static strength

We may now sum up these facts in their relation to the static strength of slowly cooled steels as follows:

Free ferrite has a maximum tensile strength with maximum ductility.

Pearlite a maximum tensile strength with low ductility.

Free cementite confers added hardness and brittleness, with a consequent lowering of the tensile strength.

Thus, it is apparent by increasing the amount of Pearlite in steel we increase the static strength but with a corresponding decrease in ductility.

Heat treatment

Heat treatment in general consists of regulating or changing the structure of steel by various methods of heating and cooling. The nature of steel is complex, and its structure may be modified or completely changed by various degrees of temperature, all of which take place in steel in its solid form. These changes take place at temperatures known as *critical ranges*.

They are denoted by the letter A followed by the letter c signifying heating or the letter r signifying cooling. These signs Ac or Ar are further modified by the numerals 1, 2 or 3, indicating the particular point referred to. Thus, Ac 1 would mean the first critical range passed upon heating.

In considering this diagram let us devote our attention to the steel in question, spring steel, .90 to 1.00 per cent carbon, in its normal condition resulting from slow cooling, or in the annealed state, in that it consists of .90 per cent carbon consisting entirely of Pearlite.

Let us first consider the influence of temperature on the constituent Pearlite while passing through the Ac 1-2-3 range. Practically no change in this constituent occurs during heating until a temperature corresponding to the critical range is reached, which in this case is approximately 1,340 deg. to 1,400 deg. F. (727 deg. to 760 deg. C.).

In passing through this critical range there is a complete change in the nature and structure of the Pearlite. It is converted into a new constituent with new characteristics. This is technically known under the term solid solution, microscopically called Austenite. This new constituent, save that it is a solid and not a liquid, has all the properties of a liquid solution. Its original components are merged into a single entity, giving a complete indefiniteness of composition with entirely new characteristics. When quenched in oil at a temperature of 1,340 deg. F. and not over 1,400 deg. F., it passes through a transition and is known microscopically as Martensite. In spring steel Austenite as such cannot be retained by the ordinary methods of oil quenching but changes into Martensite.

Spring steel when slowly cooled from above this critical range of 1,340 deg. F. passes out of solution as Austenite and takes the original Pearlite structure. This is important to note as this fact which is little appreciated is the cause for many spring failures which will be explained in a discussion of quenching media.

Refinement and grain size beyond Ac 1-2-3

At slightly above the critical point in .90 to 1.00 per cent steel (spring steel) the original Pearlite grains are changed to Austenite as previously explained and

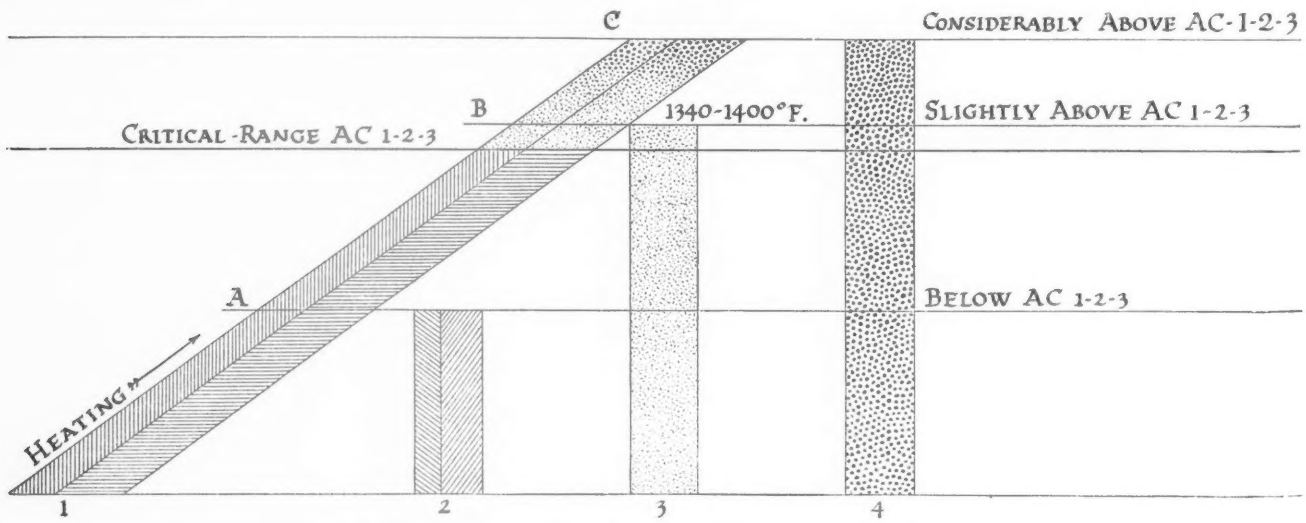


Diagram representing the structural changes which take place in Pearlitic spring steel as it is progressively heated through and beyond the critical range

will possess that maximum refinement which the formation of Austenite can impart. As the temperature is progressively raised above the critical 1,340 deg. to 1,400 deg. F., a gradual coarsening of the Austenite grains occurs with attending weakness in the oil quenched spring.

A very clear understanding of these principles must be had as it is a lack of understanding of these facts that is the cause of many spring failures.

Hardening

The operation of hardening spring steel involves two specific operations of change in temperature, heating and cooling. The function of heating is first to obtain the best refinement, and secondly to obtain the formation of Austenite. The steel must then be held in this condition by very rapid cooling in oil. Associated with both the heating and quenching there must be as great a degree of uniformity as is possible. This is important to note.

Spring steel when properly hardened should show no trace of the original Pearlite structure, coarse grain size, or any other peculiarities of untreated steel. If such is present in the hardened steel it goes to prove the operation was not properly carried out. If the structure of the Austenite has not been suitably developed by the

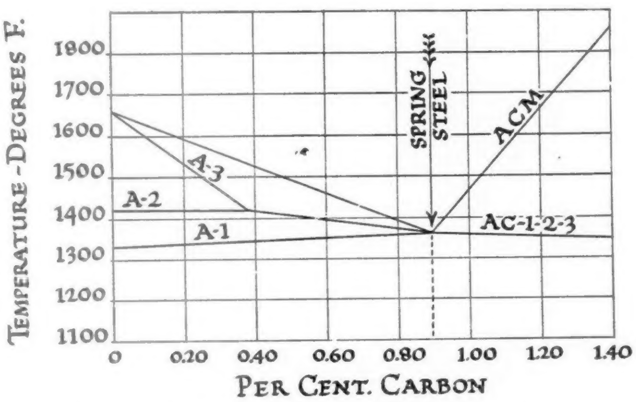


Diagram showing various critical ranges of steel.

heating operation, it will not be altered for the better by subsequent quenching. The most any quenching media can do is to retain the characteristics which the heating operation develops.

Column 1 in the above diagram represents a normal .90 to 1.00 per cent carbon pearlitic spring steel and the structural changes taking place in that steel as it is progressively heated through and beyond the critical range Ac 1-2-3, and we will assume that the structure and microscopic constituents obtained by heating to various temperatures, such as *A* to *C*, may be retained by use of a proper quenching medium as illustrated by columns 2 to 4.

By heating to temperature *A*, under the critical range Ac 1-2-3, 1,340 deg. to 1,400 deg. F., no change will be produced in the original steel, which consists of Pearlite. The quenching likewise will produce no change, as shown in column 2. Heating to slightly over the critical Ac 1-2-3, 1,340 deg. to 1,400 deg. F. will change the Pearlite to solid solution Austenite if held a sufficient time to effect complete diffusion. This will entirely refine the steel, giving it the finest grain size possible.

Quenching column 3 will retain the condition in the form of Martensite, developing the maximum hardness possible. Heating to temperature *C* considerably over that of the upper critical range will tend to increase the grain size, and quenching column 4 will retain this condition and consequently developing a brittle steel.

Heating for hardening of spring steel should be slow, uniform and thorough and to the lowest temperature which will give the desired result. This is due to the setting up of stress which follows rapid cooling. Overheating has been the cause of over 80 per cent of the spring failures checked by the writer on complaints of bad steel. Both theory and practice support the old rule that "The lowest heat which will give the desired results is the best."

Quenching media

The primary consideration of an oil bath for quenching spring steel is the rapidity with which the heat is removed. This property of transference or conductivity is most important. Its ability to arrest Austenite in its Martensitic form is its outstanding attribute.

Animal and vegetable oils will harden satisfactorily when fresh, or when first used. Upon continued use the quenching speed lessens. Any liquid which will not ignite will harden partially. Originally the animal and vegetable oils were employed exclusively for quenching, upon the theory that these two groups of oils possess a much higher flash and fire than mineral oils, but as the temperature of the steel was always at least 1,000 deg. F. higher than the ignition point of any oil, it was afterwards discovered that the ignition or flash point was of no consequence, provided sufficient volume and circulating facilities were used.

It is a well established fact that all animal and vegetable oils oxidize when continually subjected to high temperatures, developing a change in viscosity and a corresponding change in the quenching speed. This change in quenching speed causes unsatisfactory hardening, as the Austenite developed in heating from 1,340 to 1,400 deg. F. is not arrested in the desirable form of Martensite. It shows a semi-Mratensitic Pearlitic structure. This structure does not develop the physical properties necessary to long spring life.

Petroleum oils are peculiar in the fact that they are composed of an innumerable number of hydro-carbons of different boiling points. These hydro-carbons distill out gaseous vapors in the order of their respective boiling points, causing a constant change in viscosity upon continued use. This change in viscosity brings about a similar condition as noted with respect to animal and vegetable oils, and should be avoided for the same reasons in spring work.

Investigation into other quenching media indicates that oils distilled from Degras (wool grease) approach nearest the ideal. These products have all the desirable characteristics, with but few of the undesirable. The quenching speed is more rapid and uniform over a greater range of temperature, the viscosity is constant, the oils do not distill, and while of a hydro-carbon nature, they will saponify under pressure. The use of such a product, with the steel and temperature factors correct, insures the desired development of the microscopic constituent Martensite in the hardening operation.

The impression exists that flash and fire points are essential characteristics of desirable quenching media. Investigation into this subject reveals the fact that, as no oxygen gets into the oil below the surface, and that so long as the oil on the surface which is exposed to the air, does not reach the temperature of its fire test, there can be no ignition, no matter how much heat is introduced into the oil under the surface. For such reasons, flash and fire values are not of importance.

Tempering and drawing

The prevalent practice in the past has been to perform the drawing or tempering operation by the flash back

method which has been productive of very unsatisfactory results. Absolute uniformity of the drawing temperature should be applied in the drawing back operation which cannot be accomplished by the flash back method or by drawing in furnace atmosphere at comparatively low temperature.

The most successful method of performing this operation is the use of a salt bath. A high temperature thermometer placed in the molten salt will indicate the desired temperature for the spring to be drawn. The springs can then be emerged into the bath and when the bath attains the predetermined temperature they can then be withdrawn with the assurance that the application of temperature has been absolutely uniform throughout. The result is a complete spring with the highest physical properties possible to develop in consideration of the character of steel used in its manufacture.

When a piece of spring steel is heated to slightly above its critical point—Ac 1-2-3, 1,340 deg. to 1,400 deg. F.—and quenched with a satisfactory quenching oil the necessary initial hardness is developed. But the inevitable stresses caused by rapid cooling render spring steel unsatisfactory for service in this condition. In order to render spring steel ready for service a further transition is necessary. This is brought about by further application of heat, which will now accomplish two things. It will relieve the hardening strains and so permit the transition of the spring steel from its Martensitic or hardened form to that known as Troostite. By properly adjusting the temperature of this reheating process the desired stage in the Martensitic Troostictic transition may be obtained. This stage is developed in spring steel between 650 deg. to 750 deg. F. (343 deg. to 399 deg. C.).

If spring steel has been properly heated and quenched so that it is composed of Martensite without grain growth developing the highest initial hardness, Troostite will begin to form at approximately 400 deg. F. (204 deg. C.). As the tempering or drawing temperature is progressively increased, the Troostite increases in amount until 750 deg. F. at which point it begins a further transition into Sorbite. To carry spring steel over into Sorbite causes set; to neglect the development of Troostite encourages fracture provided the heating and quenching operation has been carried out to that point.

Hence, we arrive at the necessity for the control of temperature on the drawing or tempering operation. The old flash back method proved unsatisfactory due to the inability of the operator to control temperature. Dry heat, such as was and is used, has a very low heat conductivity. Temperatures between 680 deg. to 750 deg. F. cannot be indicated by sight and recording instruments are not satisfactory for this purpose.

When the spring leaves are introduced into the bath the temperature falls and when it assumes the pre-determined temperature the leaves can then be removed and quenched in water, the water bath being used only to wash the excess salt adhering to the leaves.

By maintaining the bath at the proper temperature there can be no over-heating, developing Sorbite. The heat must penetrate all parts of the steel alike and the personal equation is as nearly eliminated as is possible. This method has the further advantage of cutting down labor costs and increasing output, since a number of leaves may be heated at the same time.

Oftentimes what is known as initial set causes misunderstanding. Initial set is developed in all heat-treated work, due to lack of molecular cohesion, and allowances for this set should be made in setting springs of both the elliptic and coil type. If this is appreciated no springs need be rendered useless, due to permanent set. Coil springs that have taken a set should be heated to 1,600 deg. F. (871 deg. C.) and expanded approximately one-quarter to one-half inch above the specified height to allow for the initial set and then again be processed as described.

Springs when removed due to leaf failure by fracture should be dissembled and all leaves subjected to the same heat treatment as the untreated steel for the reason that the spring in service being subjected to repeated stresses has partially crystallized, causing an attendant weakened condition. The assembled spring then has all the physical characteristics of the new spring and should give the same life in service.

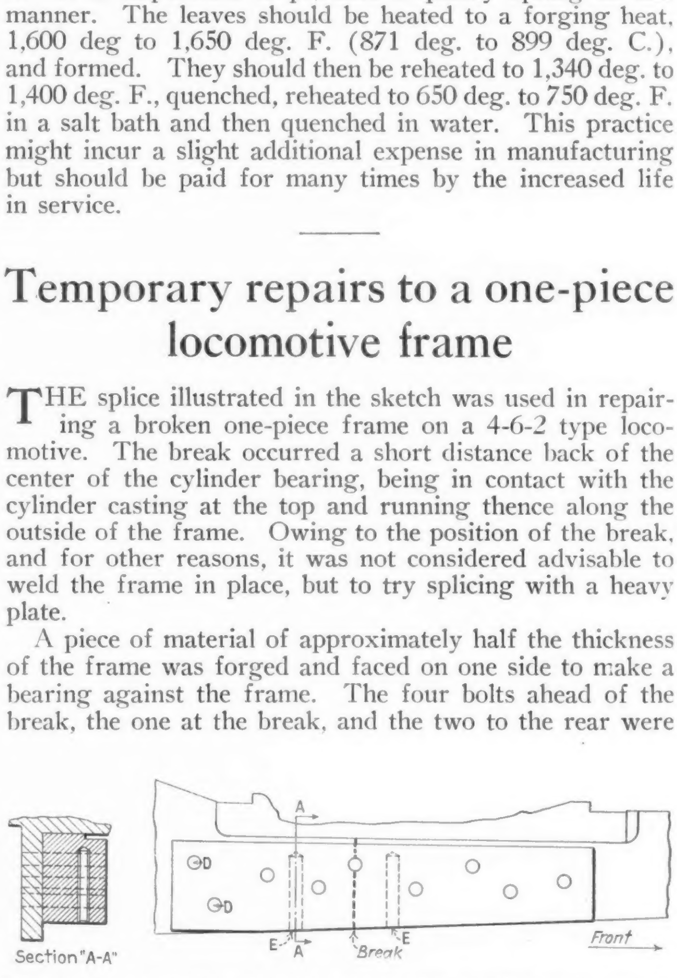
Forming operation

It is common practice to heat the leaf, form and quench it. It is impossible to produce a quality spring in this manner. The leaves should be heated to a forging heat, 1,600 deg to 1,650 deg. F. (871 deg. to 899 deg. C.), and formed. They should then be reheated to 1,340 deg. to 1,400 deg. F., quenched, reheated to 650 deg. to 750 deg. F. in a salt bath and then quenched in water. This practice might incur a slight additional expense in manufacturing but should be paid for many times by the increased life in service.

Temporary repairs to a one-piece locomotive frame

THE splice illustrated in the sketch was used in repairing a broken one-piece frame on a 4-6-2 type locomotive. The break occurred a short distance back of the center of the cylinder bearing, being in contact with the cylinder casting at the top and running thence along the outside of the frame. Owing to the position of the break, and for other reasons, it was not considered advisable to weld the frame in place, but to try splicing with a heavy plate.

A piece of material of approximately half the thickness of the frame was forged and faced on one side to make a bearing against the frame. The four bolts ahead of the break, the one at the break, and the two to the rear were



The break occurred a short distance back of the center of the cylinder bearing

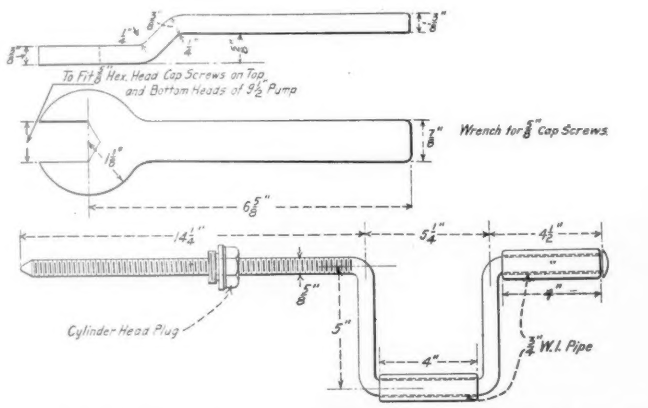
removed. The piece was laid out and drilled, with two extra holes added near the rear. These were later drilled through the frame making the arrangement as shown, with four holes on each side of the break. After the bolt holes were reamed and the bolts fitted, two holes were drilled, one forward and one back of the break, as shown at *E*. These were reamed and plugged, the center line of the plug being at the inner face of the plate at the bearing against the frame. The plugs acted as keys to overcome any possible shearing of the bolts. After they were driven slightly beyond the surface, the ends of the holes were closed over the plugs to prevent their dropping out in case the splice should work.

No trouble was experienced with the patch loosening after the locomotive was placed in service.

Device for forcing up pistons on air pumps

By E. A. Miller

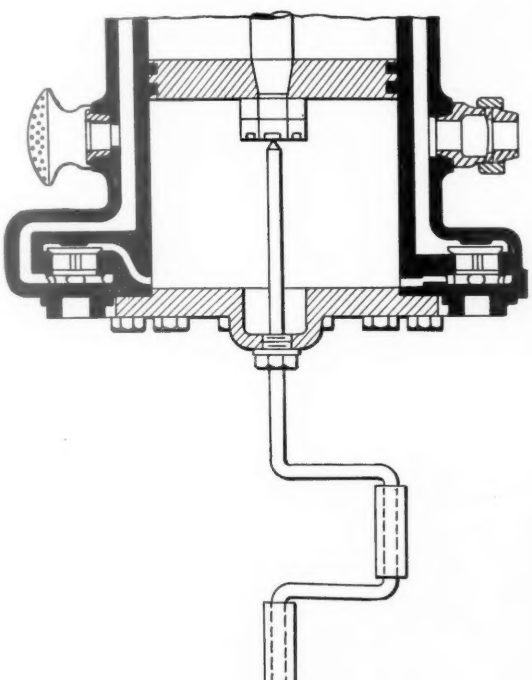
THE operation of removing the top head gaskets, reversing valves and rods from air pumps while on a locomotive is somewhat difficult. To do this it is necessary to remove the reversing valve stem which extends down into the piston rod



A device for facilitating the removal of top heads and gaskets from air pumps

which is drilled a certain distance from the upper end. This makes it necessary to force the pump pistons about half way up in the cylinder.

The device shown aids greatly in performing this work. It is made of 5/8-in. round iron or steel, threaded and bent.



Application of device for forcing up air pump pistons when removing top head or gasket

It is necessary to put the center handle on prior to making the final bends. A regular air cylinder head plug is drilled and tapped 5/8 in. to suit the threaded portion of the handle. The illustration shows the method of using the device to force up a piston. After the piston is once forced up it can be held there indefinitely. This is an improvement over the old method of pushing up the piston by putting an iron bar through the cylinder plug hole. If the friction of the piston rings and piston rod packing was not great enough, the pistons would settle back into place before the work on the pump could be completed.

Progress boards for the wheel gang

By J. Robert Phelps

Apprentice instructor, Atchison, Topeka & Santa Fe, San Bernardino, Cal.

A BOARD kept at the crank pin and axle lathes, for following up the work on crank pins and axles is shown in Fig. 1. It shows the locomotive number and date of wheel-

Fig. 1—Progress board located at the crank pin and axle lathes

ing and what is to be made for it. It keeps the machinist informed as to what work is to be done next and, as he completes the job, he draws a circle around the item on the board, indicating the completion of that particular job.

Fig. 2—Chart board which indicates the progress of the repairs to tires and journals

Fig. 2 applies in the same way to the turning of tires and journals. This arrangement helps to keep the foremen and the machinists posted as to what should be done next. For

example, all the tires may be turned for a locomotive except one pair, these being delayed because there are some broken spokes in a wheel which are being welded. Additional delays may be caused by the gas welders bringing a pair of wheel centers up to standard size, a journal waiting for a hub liner to be applied, or the store house slow in furnishing a main pin. The boards are changed each week on line-up day. They act as a check so that the right job is done first and no important part of the work is overlooked.

Fixtures for holding distributing and triple valves

By H. J. Duernberger
Air brake repairman, Michigan Central, Niles, Mich.

THE common practice when repairing distributing and triple valves, is to hold them in a bench vise. At best, this is an awkward method of holding the valves and considerable time is lost in changing them from one position to another to repair a particular part. In order to eliminate the time lost in making so many changes in the vise and also to make the job much easier, the writer developed a fixture for holding these valves which is used at all the principal repair points on the Michigan Central.

Fig. 1 shows a general assembly and detail view of the various parts of the fixture for holding the distributing valves. The base *J* of the fixture is bolted to the work bench with the removed portion flush with the front of the bench, and not over four feet from the regular bench vise so as to have it convenient for holding small parts from the valves. The stud at the center of the base passes through a hole in the bottom of the fixture. It then can be clamped in any position by the handle *P*. The distributing valve is bolted

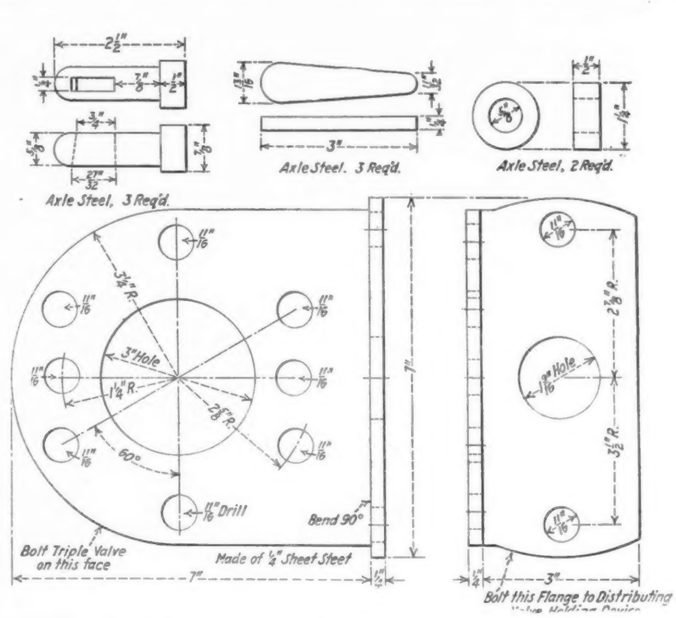


Fig. 2—Attachment used on the distributing valve device for holding quick action triple valves when making repairs

to the revolving head *B* in the fixture. It can be turned in any position by loosening the handle *I* and dropping it to the vertical position. The entire device can be turned to any

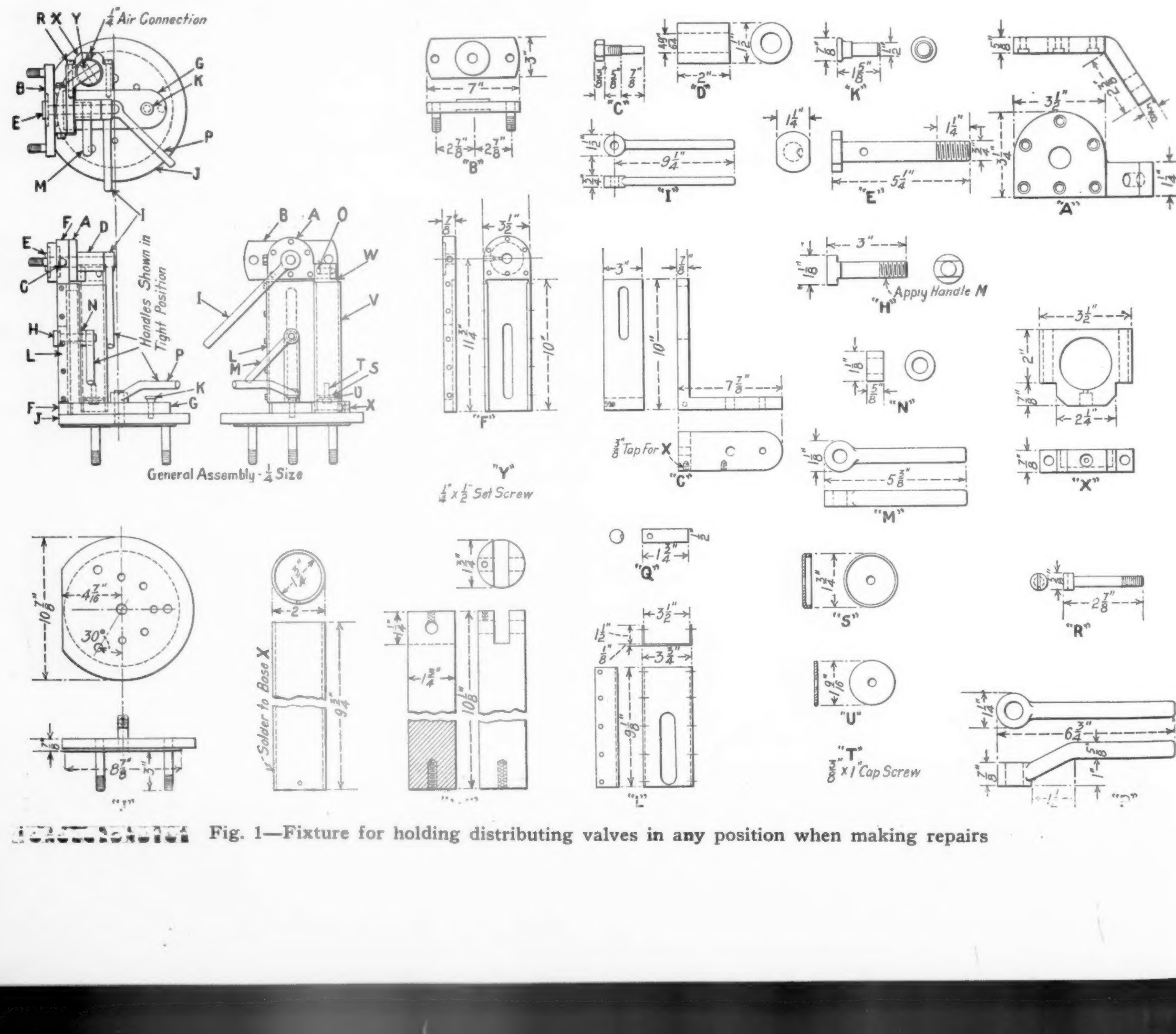


Fig. 1—Fixture for holding distributing valves in any position when making repairs

horizontal position by loosening the handle *P* and pulling out the pin *K*.

It is also provided with a raising feature which is very desirable when spotting in exhaust valve or equalizing slide valve seats. For all other work the lowered or normal position is the better. The fixture is raised by using compressed air. This is accomplished by using two 1/4-in. street ells at the point marked for an air connection. One ell should stand in a vertical position and the other be screwed into it so that it will face the rear of the work bench. Into this ell screw a 1/4-in. three-way cock. Then take a 1/4-in. drain cock and drill a 3/32-in. hole in one side of it and in the other side a 1/16-in. hole. By using a 1/16-in. side opening a more gradual lowering movement can be obtained than with a larger opening. The three-way cock is connected to the shop air line with a piece of welding hose which should have enough stock in it to allow for swinging the device. The full raised position is 7½-in. higher than the normal which is desirable for the work mentioned.

Triple valve holding fixture

Fig. 2 shows an attachment for holding quick action triple valves while making repairs. It will hold valves with either two or three holes in the flange. It can also be used by a right or left handed workman. The one flange of the device bolts to the revolving head on the distributing valve jig. The two washers shown go on the two 5/8-in. studs on the revolving head plate and are held in place by two 5/8-in. nuts. The triple valve is then bolted to this plate with the bolts and wedges shown. These are used instead of threaded bolts as quicker results are obtained. This attachment, used on the distributing valve fixture, gives the latter the same advantage in repairing triple valves as when utilized for repairing distributing valves.

Replacing crank pins equipped with eccentric arms

How to eliminate the possibility of errors and reduce the cost of application

By R. B. Robinson
Machine shop foreman, Atlantic Coast Line, Hot Springs, Fla.

When replacing main crank pins having eccentric arm connections, there are two general methods used:

First.—The crank pin is pressed into the driving wheel blank at the eccentric arm end and then, after the valves are set and the required position of the eccentric arm on the crank pin is found, the keyway is cut, the holes drilled and the eccentric arm is fastened to the crank pin.

Second.—The keyway is cut, the holes drilled in the crank pin and all work on the crank pin necessary to complete the fastening of the eccentric arm is done before pressing the pin into the driving wheel. Of this method there are two cases, *A* and *B*, referred to in accompanying illustrations.

Case *A* is the one generally used. This method will be compared with Case *B* to show the saving of time, the possibilities for the elimination of error, the simplification of method and the reduction of cost in the application of Case *B*.

Application of Case A

The first step of this method is that of scribing a line on the driving-wheel fit of the crank pin and continuing it to the eccentric arm fit at that end of the pin. This line is scribed before the crank pin is taken from the lathe and, when correctly scribed, is the line that would be made by the intersection of a plane through the centers of the crank pin, with the surfaces of the fits involved. It is this line which determines the position of the eccentric arm on the pin and the position of the crank pin. It also acts as a guide as the pin is being pressed into the driving wheel.

After this center line is scribed on the pin, the next step is to locate on the edge of the crank pin bore of the eccentric arm the point through which passes the line on the eccentric arm connecting the center of the eccentric pin with the center of the crank pin bore. This is the center line of the eccentric arm, and, when the arm is placed on the crank pin, is made to coincide with the scribed center line on the crank pin. The eccentric arm, after being fastened temporarily to the crank pin, has located on it the position of the keyway and its outline scribed on the crank pin. If the key way is the least bit out, the key must have an offset to make necessary corrections, for it is essential that the eccentric arm retain its position relative to the scribed longitudinal line on the crank pin, as this line is the one by which the crank pin is located in the driving wheel.

After the key is fitted and the eccentric arm is in the correct position on the crank pin, the pin is ready to be drilled for the eccentric arm bolts and then pressed into its place in the driving wheel.

After being slotted, drilled and otherwise prepared, the position of the crank pin in the driving wheel is determined by the longitudinal center line scribed on the crank pin intersecting at right angles another line scribed on the face of the driving wheel. This line is found by scribing a line through the center of the crank pin hole in the driving wheel and the point on the eccentric pin circle corresponding to the location which the center of the pin end of the eccentric arm is to have. This line is also made use of in the same manner in Case *B*.

The length of the eccentric arm and the diameter of the eccentric pin circle determine the location of the eccentric arm on the crank pin, and with this data, the position in which the finished crank pin is to be pressed into the driving wheel is found.

In the first method, that of fitting the eccentric arm to the crank pin after pressing the crank pin into the driving wheel, an error is not so likely to occur, but other complications arise. In small shops, not equipped for drilling and slotting outside of the machine shop, the situation becomes awkward. The cost of the work in preparing the

crank pin for the eccentric arm is much less if the work on the pin is all done in the machine shop before the pin is pressed into the driving wheel. While it becomes a simple matter to do all the necessary work on the crank pin before it is in place in the driving wheel every care in Case *A* must be taken in laying out the work.

Method of using Case B

In Case *B*, the laying out of the work becomes simplified and there is hardly any likelihood of an error. The length of time required to prepare the crank pin is less, as is the cost of the operation.

All that is required when using this method is to remove the turned pin from the lathe without any determining mark having been established on it (except, of course, the two center holes) and then to place the eccentric arm in position on the pin. Then run a scriber along the edge of the keyway in the eccentric arm, scribing its outline on the pin, remove the arm, cut the keyway in the pin, replace

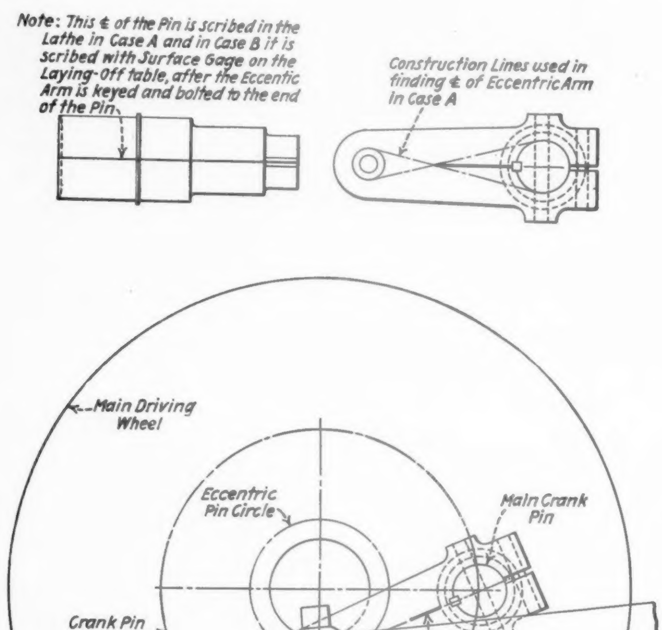


Diagram showing the method of scribing lines on crank pins and eccentric arms preparatory to replacing on the wheels

the arm on the pin and key it. After this, clamp the arm, drill the necessary holes, and fit the bolts in the pins. The next step is simply to place the assembled crank pin and eccentric arm on the laying-off table, and level it up so that the two centers of the crank pin and the center of the eccentric arm are all in the same plane parallel to the plane of the table surface. Then, with the surface gage set to the height of this plane, scribe one line along the driving wheel fit of the crank pin, allowing it to extend just over on the rod bearing fit so as to be visible for use in checking purposes after the pin is driven into place in the driving wheel.

The eccentric arm is then removed and the crank pin pressed into place, with its scribed line kept coincident with the end of the scribed line on the surface of the driving wheel, or, as already mentioned, in the same plane with it. Should the pin twist out of place before the act of pressing it in is completed it can be coaxed back into line with a chain and lever. This turning force is, of course, applied simultaneous with that of the pressing-in force.

The above description covers three ways of replacing a main crank pin when the valves are actuated from the movement of the crank pin by means of an eccentric arm fastened to it. The goal is to accomplish the installation of this pin in the simplest, most economical, and at the same time the most accurate, way.

The first method described is simple in plan but expensive in labor, time and power utilized. The second way, Case *A*, is economical as regards machine work, but requires the utmost care in laying out and, if the keyway on the crank pin and the subsequent drilling of the pin is not exact, troublesome and expensive allowances will have to be made. The third way, Case *B*, eliminates possible errors to a minimum and does not require the painstaking time of laying out the work that is required in Case *A*. The eccentric arm is simply keyed and bolted to the main crank pin in any radial position, then leveled up on the laying-off table and scribed. It is then ready to be pressed in the main driving wheel.

Eliminate guesswork in metal cleaning

THE days of guesswork are over. Industry of all kinds today is operated by accurate systems and rules that leave little room for deviation.

Present day business conditions demand that rigid economy be practiced, that the needless worker be dismissed, the needless machine junked, and needless expense stopped. This economy is perhaps of necessity even more rigid in the railway shop than in some industrial organizations.

Railway shops of every kind have cleaning of one sort or another to perform, such as the cleaning of air pumps, injectors, sheet metal, small parts, and the hundred and one materials that must be freed of their coating of oil or grease before inspection or before repair work can be undertaken. Modern cleaning materials have proved their superiority to commercial chemicals and ancient systems, but the economy to be gained from modern methods can only be greatest when a minimum of cleaning material is used. Modern metal cleaners, which may combine both chemical and mechanical action, cost more than lye or soda ash, but the quickness and thoroughness of their action outweigh the difference in price. In checking up the economy of each shop, some way must be devised to see that those actually putting metal cleaning material in the tanks do not waste it.

Proper amount of cleaner important

It has been proved that more time is lost in metal cleaning operations by the use of too much cleaner than by using too little. Aside from the time lost, the cost of the needlessly used cleaner soon totals a considerable sum. It is true that in many non-railway shops both of the above factors are far overbalanced by the use of improper and inefficient methods—no cleaning material is economical unless it is used in the way in which it was intended. The addition of air agitation, for instance, may materially reduce cleaning time and expense.

It would seem impossible that a cleaning tank operated under ordinary supervision could become so clogged with

cleaner that its effectiveness could become less than half normal. Such, however, is a frequent happening and until such conditions are eliminated, and until the practice of shoveling into the tank unrestricted amounts of cleaner is stopped, cleaning expense will be far above what it should be.

It does not take a trained chemist or mathematician to determine what amount of cleaner to add to a solution to maintain its efficiency. On the other hand, when a cleaner is costing six, eight, or ten cents a pound it is hardly wise to allow some unskilled laborer to shovel in more cleaner when things do not just suit him. Such methods frequently slow up cleaning instead of speeding it up.

The surest method of maintaining a metal cleaning solution at efficient and economical cleaning strength is by the normality test. The operation of this test is easily accomplished by any worker of average intelligence, and the apparatus required should cost but a few dollars. Unfortunately, the hydrometer test does not show the actual strength or alkalinity of a cleaning solution, inasmuch as it gives only specific gravity, which is affected in proportion to the amount of foreign matter in the solution. The hydrometer reading of a newly made cleaning solution is fairly accurate. Hydrometer readings are not, however, sufficiently accurate upon which to base computations for the recharging of a used solution.

Method of testing

After making up a solution of an alkali cleaning material, a simple method of determining the proper amounts of cleaner to add from time to time to maintain the original strength is as follows: When the solution is first made—for sake of illustration say three ounces to the gallon—obtain by means of a graduate marked according to the Metric system a 10 c.c. sample and allow it to cool. Then add a couple of drops of methyl orange solution (this may merely be labeled bottle No. 1), which turns the cleaning solution an orange color. Then, using a graduated burrette with a glass valve (and this is not nearly as technical as it sound in print) a solution of 10 per cent normal sulphuric acid is very slowly added until the cleaning solution in the beaker changes from orange to red. Sulphuric acid of this strength is readily obtainable and may merely be labeled bottle No. 2. A record must be kept of the number of graduations of acid required from the burrette to turn the sample of cleaning solution from orange to red.

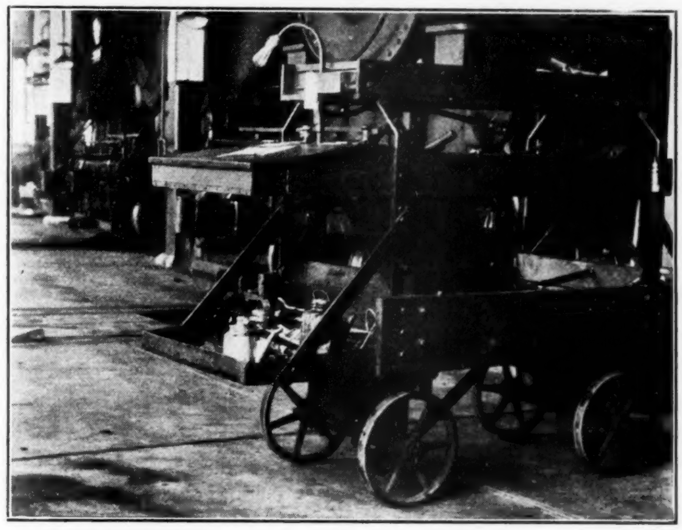
For example: If the initial test of the new solution required ten graduations of acid to turn the solution from orange to red, and if after using the solution and again testing as outlined above, it only takes nine graduations of acid to change the color of the solution, it shows that the cleaning solution has lost one-tenth of its original strength. It will therefore require but one-tenth of the original charge of cleaning material to bring the solution back to its original strength.

But how much chance is there of getting only the necessary amount of cleaner in the solution if someone is shoveling it in the tank by guess? And as the average person overguesses, the tank may soon be so supercharged with cleaner as to seriously retard the action; and then, of course, the particular cleaner being used is immediately pronounced unsatisfactory.

You do not guess in paying your men, or in paying for your various materials or supplies. Why guess at your cleaning operations? Why not know what amount of cleaner is needed to run a certain tank for a specified time or some certain operation, and then see that that amount is used, and no more.

Convenient wagon for the locomotive inspector

A WAGON which has been especially designed to meet the needs of the locomotive inspector is shown in the illustration. It is provided with three trays or boxes for tools, a shelf for oil containers and lubricants and a desk equipped with an electric light which can be plugged in at the nearest available wall socket. The lower tool tray has sufficient overhead clearance to permit it to be utilized for heavy tools and certain locomotive parts which can be quickly repaired or replaced by the locomotive inspector



An inspector's wagon which may be moved to any place desired—Accommodations are provided for a desk, tools and necessary equipment

and his helper. The two top trays are convenient for the lighter hand tools such as hammers and wrenches, which are used more frequently. The desk has a lifting lid with compartments inside for the various forms and stationery necessary in making out work reports.

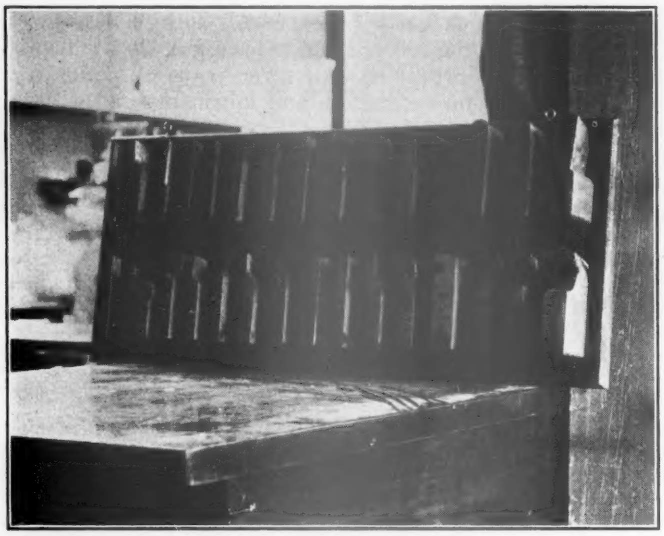
Wooden models for forging machine cutting tools

IT has been found from experience that the average blacksmith can forge out a better piece of work from an actual sample of the work than when he has to work from a drawing. One of the exacting jobs which a railway blacksmith has to do is the forging out of machine cutting tools preparatory for grinding.

It was found at the Billerica shops of the Boston & Maine that the blacksmiths were unable to satisfactorily forge these tools from blue prints. In order to overcome this trouble the drawings of 31 different types of lathe, planer, sharper and slotters tools were collected and taken to the pattern shop. The pattern maker carved to size, out of wood, exact duplicates of the actual tools and mounted them on a board. On the top edge of each tool it painted the dimensions of the steel from which the tool is to be forged. These tool models are also numbered from 1 up to 31.

This board is placed near the forge of the blacksmith who makes the tools. When a machinist needs a new tool he has his foreman make out a shop order on which is

written the number of the tool he wants made. This slip comes to the blacksmith who matches the number of the tool on the slip with the corresponding number on the

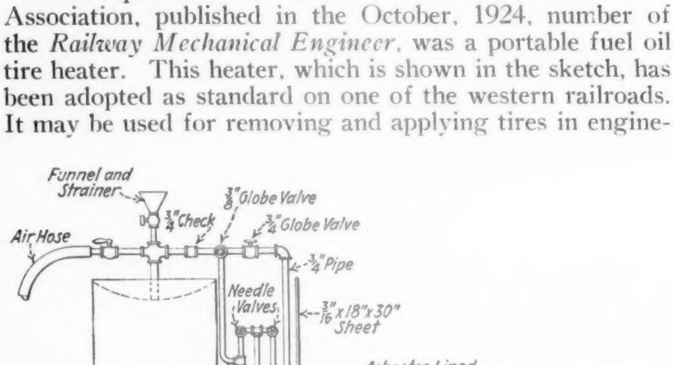


Models of 31 machine cutting tools to be used as guides by the blacksmith

board. This gives him a full size model to work from which has resulted in more accurate forgings. Thus less grinding by the machinist is required.

Fuel oil tire heater

Among the various labor saving devices described in the report of the convention of the General Foremen's Association, published in the October, 1924, number of the *Railway Mechanical Engineer*, was a portable fuel oil tire heater. This heater, which is shown in the sketch, has been adopted as standard on one of the western railroads. It may be used for removing and applying tires in engine-



Sketch of portable fuel oil heater

houses as well as in back shops. It is claimed to be an economical consumer of oil and simple to operate.

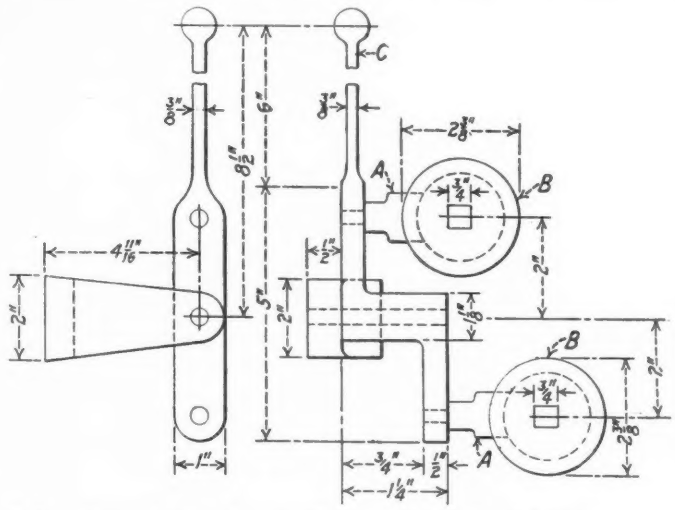
Referring to the sketch, the tank is filled with fuel oil through the funnel and strainer. Air pressure is supplied from the shop air line through the air hose shown at the extreme left. The air pressure forces the oil to the pre-heating torch *A*, which heats the main coil *B*. The circulation of the oil and air through the coil *B* causes the oil to be broken up into small particles and it is passed in this condition to the tire hoop. The rate of combustion is regulated by the globe and needle valves shown in the sketch.

This device can heat a tire for removal or application in 12 min. The heating process is so rapid that the wheel center does not absorb sufficient heat to interfere with the rapid expansion of the tire which makes it a most effective heater.

Feed gear shifting lever for Morton shaper

In order to facilitate the shifting of the feed gears on a Morton draw-cut shaper an operator employed in a large eastern railroad shop has devised the safety lever shown in the sketch.

A bracket and lever was bolted to the cross rail of the machine to eliminate the necessity of having to reach while sliding the feed gears into place. The gears *B*

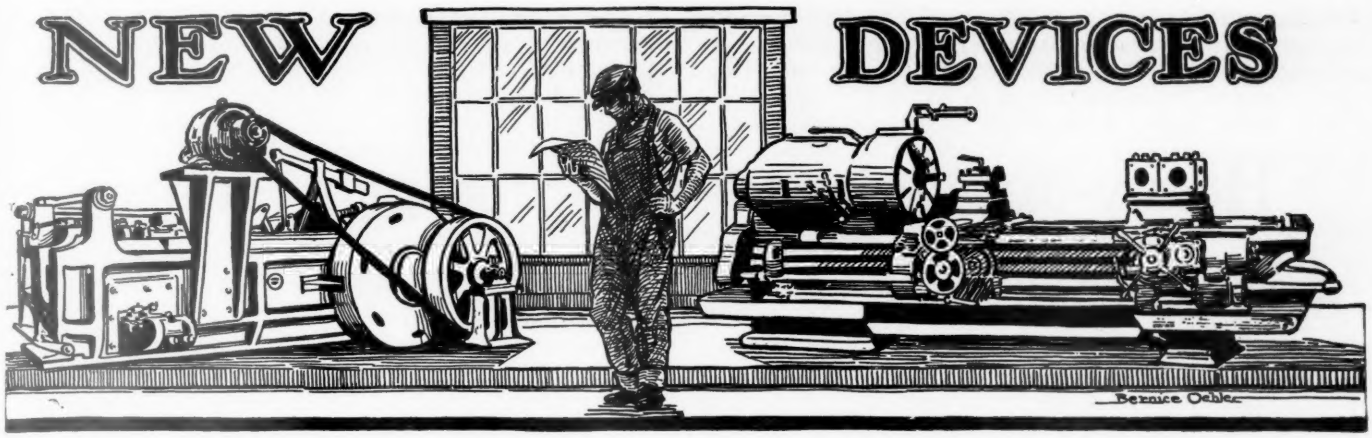


Safety lever designed to facilitate shifting the feed gears on a Morton draw-cut shaper

are grooved to receive the lugs *A* which are manipulated by the lever *C*.

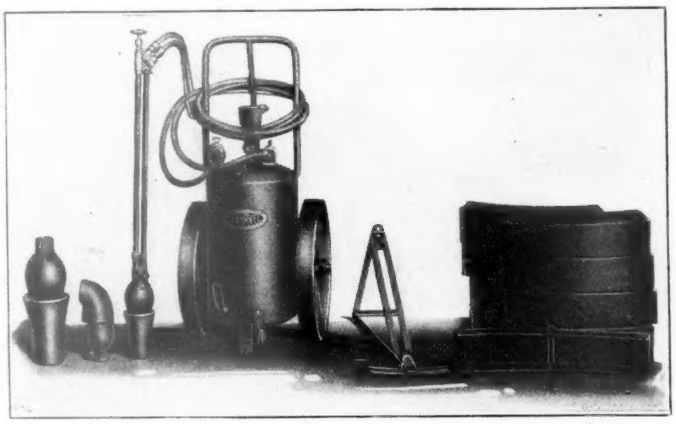
Only one gear is needed at a time to feed the table across the rail. The function of the other gear is to raise or lower the table. When one gear is in use the other gear is held in its proper position so that it will not accidentally slip into mesh.

Handling heavy castings without adequate crane service is expensive



Mahrvel vacuum torch and tire heater

THE Mahr Manufacturing Company, Minneapolis, Minn., has recently added a tire heating unit to its list of oil burning equipment. This equipment operates without pressure on the oil tanks or hose



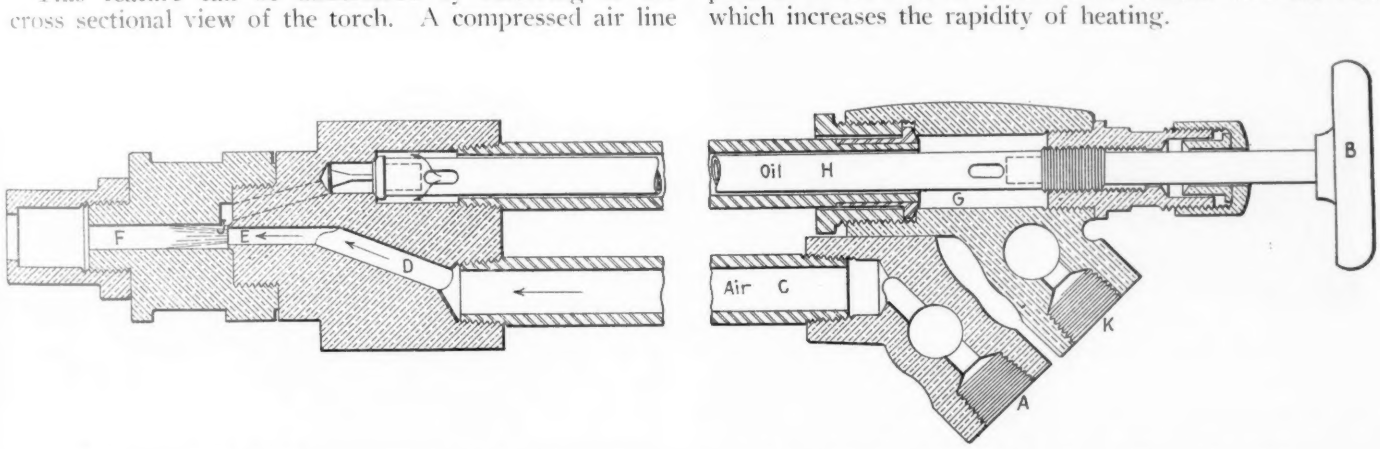
Vacuum torch and tire heater which operates without pressure on the oil tanks or hose lines

lines and therefore, removes the risk of fire or accident from bursting.

This feature can be understood by referring to the cross sectional view of the torch. A compressed air line carrying pressures ranging from 50 to 125 lb. per sq. in. is connected at *A*. The flow is regulated by the handwheel *B*, allowing it to pass through the drilled passages *C*, *D* and *E* and the air expands into passage *F*. This sudden expansion creates a vacuum at the points *J* in the corners of passage *F* which are untouched by the air as it leaves the passage *E*. The oil supply is led to the torch through a hose connected at *K*, enters the chamber *G* and is conducted to the valve seat through the seamless tube *H*. After passing the valve it is drawn into the air stream by the vacuum at *J*, where it is atomized and delivered from the torch end in a nozzle where combustion is started and completed with the addition of atmospheric air drawn in by the action of the jet.

It is essential that there be no leaks in the oil line between the point where the vacuum is created and the source of oil supply, as otherwise, air is admitted which breaks up the continuous column of oil and causes a sputtering flame, or if large enough, breaks the vacuum entirely and prevent any oil from being drawn up. A vacuum capable of lifting ordinary fuel oil 18 ft. is about the maximum for practical operation.

This type of torch is used in connection with the No. 101 Mahrvel safety vacuum tank. The unit consists of a light stand, special nozzle and steel housing. The housing is assembled by sections around the periphery of the tire to be removed and two flames, from the bottom of the tire and in opposite directions, are forced around its entire circumference within the housing. The major portion of the heat is confined in contact with the rim which increases the rapidity of heating.



Cross-section of No. 101 torch showing how the vacuum is formed at J which draws the oil from the tank

The combination of the torch and tire heater is especially convenient at terminal points where the torch has a variety of other uses. It can be used for thawing

out locomotive ashpans, etc. It can be used for firing up locomotives; for heating parts to be straightened and preheating parts to be welded; for thawing out frogs, switches, and other mechanisms around terminals. The compressed air may be supplied from the air pump on a locomotive.

Heavy-duty planer with compact control

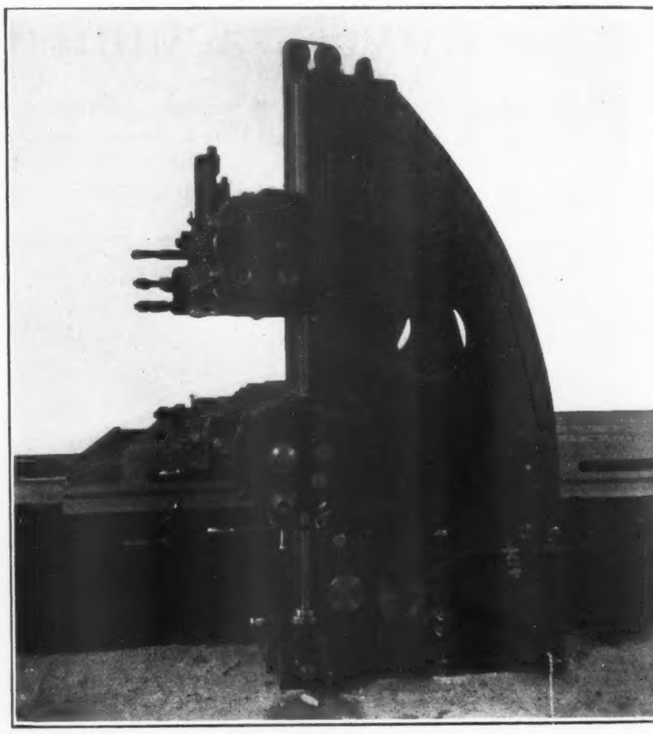
A NUMBER of features in the planer recently designed and built by the Liberty Machine Tool Company, Hamilton, Ohio, are interesting departures from current practice. The cross rail is a self-contained unit, carrying all the mechanism necessary for power rapid traverse of the heads vertically and horizontally, as well as for elevating or lowering the cross rail. The unclamping, elevating, lowering and reclamping of the rail, as well as the power rapid traversing of heads vertically and horizontally are accomplished by the manipulation of lever *A*. To be able to accomplish these various movements with one lever eliminates the possibility of two movements at one time; making the control of the rail fool proof.

The levers *B* and *C* are the feed controls of the two heads vertically and horizontally, while by turning the hand wheel *D*, any desired amount of feed can be obtained as registered by indicator *E*. The 1½-hp. motor for power rapid-traversing and elevating the rail is built in and is located directly back of the rail. It receives its current from protected trolleys and can be used on either alternating or direct current. If necessary, power may be obtained from a lamp socket. Both heads are moved on a single stationary screw which is in tension at all times. The nuts are revolved around the screw.

Liberty planer showing compact control mechanism

Lever *F* engages or disengages the horizontal feed of the left hand head or engages and disengages the vertical feed of the left hand tool slide, making it unnecessary for the operator to go to the opposite side of the machine for this adjustment, while the lever *G* controls the right hand head in a similar way.

Lever *A* controls an ingenious mechanism for clamping the rail to the housing, these clamps being located and operated on the inside of the housing. The movement of the tool slide vertically is accomplished by revolving a nut around a stationary screw which is stretched in tension.



Side view of Liberty planer showing motor for power rapid traversing head and elevating rail

The screws for elevating and lowering the cross rail serve a double purpose. These screws are also stationary and in tension, and so can be used for the purpose of feeding and power rapid traversing one or two side head thus eliminating two screws for operating a four-head planer.

The vertical shaft *H* is used only for transmitting power to the feed mechanism for both rail heads and side head, the transmission gears being so arranged that by moving lever *I* into one of two different positions, the feed may be made to take place either at the end of the cut, or just before entering the cut.

All gearing and mechanism on the end of the cross-rail for controlling the feed and power rapid-traverse, the gearing on the side head and also the feed mechanism at the bottom of the housing, run in oil. Gages indicate the oil level.

The housings extend entirely to the floor and are attached to the bed by means of reamed holes and bolts with additional heavy dowel pins for the purpose of eliminating any movement. The bed is of the double-wall type, ribbed lengthwise and crosswise and webbed

in on top. It is arranged for forced-feed lubrication to the Vs and is of double length, so the table at no time passes beyond the ends of the bed. Between the double walls of the bed are oil reservoirs for the horizontal shafts, the bearings of which are attached to the walls of the bed. Wick inserts extend the full length of the bed which convey oil, under pressure, to the bearings at all times. All oil entering these bearings must first be filtered through filtering stations in the bed, in addition, to passing through a ½-in. felt wick before entering the bearing. The machine is also equipped with a two-way pump located near the operator with a sight feed attachment so that he can make sure at all times that the oil is working properly.

The bed is also equipped with a tool cabinet for tools and clamps. A gear box is cast in the bed, in which heat-treated steel gears run continually in a bath of oil.

The table is of the box type construction provided with wide openings at the bottom of the T slots which allow the chips to fall through. This eliminates the necessity of clearing the chips from the slots before inserting clamping bolts. No mechanism appears on top of the machine, with the exception of the sheave wheels necessary to carry the counterweight for the side head.

Duplex spiral fluted staybolt tap

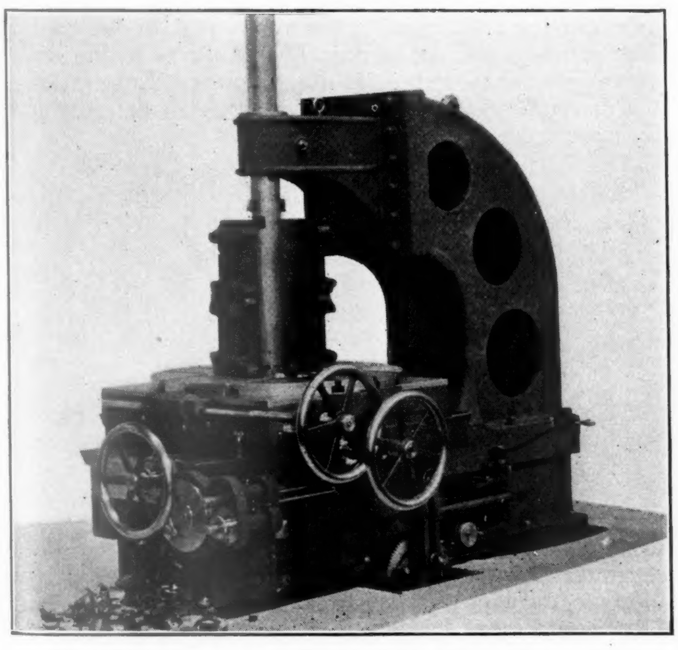
A STAYBOLT tap which consists of two spirals, opposite in direction, has recently been placed on the market by the W. L. Brubaker Brothers Company, Millersburg, Pa., under the trade name of Brubaker duplex spiral fluted staybolt tap.

Brubaker staybolt tap with the reamer portion made with a right-hand spiral

The tap is divided into five parts. Starting with the reamer end, they are the reamer, taper, thread and shank respectively. The reamer portion is made with a right hand spiral, thus giving it the action of a drill and reamer combined, while the tap is a left hand spiral, which gives it the same action as that of the regular Brubaker left hand spiral tap. It is claimed that the life of the tools are greatly increased by this design. They are manufactured by a special operation and are made of a steel carefully selected for this style of tool.

Draw stroke driving box slotting machine

A DRAW cut slotting machine primarily designed for machining locomotive driving boxes, but also adapted to a great variety of other slotting work in forgings or castings from which a large amount of metal is to be removed, or in long deep holes where the regular slotter cannot reach is a recent product of Baker Brothers, Inc., Toledo, Ohio. It will also do shaper work on the ends of long pieces of irregular shapes which are difficult to chuck on a planer. In addition it can be used for keyseating wheel centers up to 72-in. diameter.



Baker Brothers draw cut slotter set up for machining driving boxes

A 38½-in. diameter table with a 19¾-in. hole is placed low on the machine so as to be convenient for the operator. It is 32 in. above the floor level.

The bar carrying the cutting tool can be any size up to and including 4½ in. in diameter. The bar in the machine can be readily replaced by one of another size, by the substitution of suitable bushings. The support of the bar is very rigid. It is fixed at one end by clamping it in a long bearing in the driving ram, is supported by a bushing in the lower table directly below the work, and in a bushing in the upper arm directly above the work. The tool relief on the return stroke is secured by a clapper box in the cutter-bar. A 2-in. by 1-in. working tool can be used in the largest size cutter-bar.

Full automatic feeds are provided in all directions. All feeds are readily engaged by the operator when standing in front of the machine, all hand feeds being operated in the same manner. The length of the feed is adjusted at the right side of the machine.

The counterbalanced ram is driven by a rack and pinion through a heavy train of steel gearing. The reverse is accomplished by means of shifting belts which, for heavy duty, have been found very superior to any form of friction device. The shifting is actuated automatically which is an essential feature for smooth operation.

When so desired, the machine can be arranged for direct connected motor drive. A 20-hp. reversing planer type motor not to exceed 750 r.p.m. is recommended. The distance from the center of the cutter-bar to the box column is 35¼ in. The bar has a working stroke of 30 in. and an actual stroke of 33 in. The diameter of the table is 38½ in. The net weight of the machine is 18,000 lb.

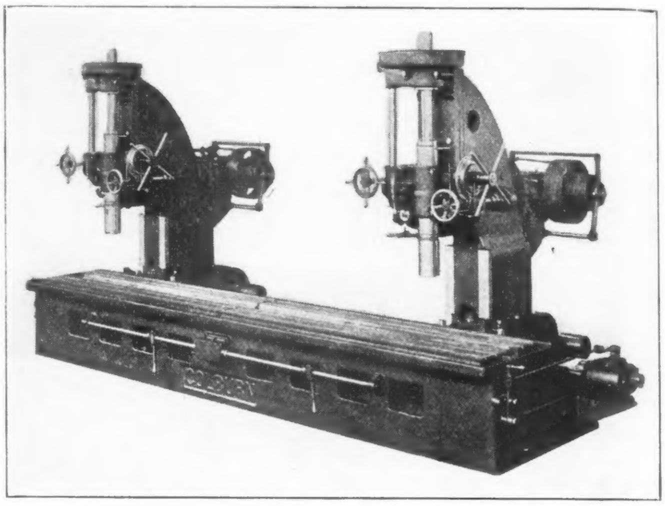
Adjustable spindle rod boring machine

THE advanced type of rod-boring machine shown in the illustration is a late product of the Colburn Works of the Consolidated Tool Corporation of America, Wilmington, Del. The machine is adapted not only to the boring of side rods, but on account of its great range, quick adjustment of heads to any desired position and the large number of speeds and feeds available, it can be used on a variety of work where holes are to be bored, drilled, faced, reamed or tapped simultaneously, or where one operation may be performed on the first spindle and another operation on the other spindle.

Each spindle is operated independently. If desired a tapping attachment may be applied to either head. Each spindle has an independent motor drive which travels with the head. These motors also furnish power for moving the heads longitudinally. The driving and feed gears run in oil. The driving shafts and the spindles are provided with ball bearings, and each spindle has a steady support and cutting compound pump. A cutting compound trough surrounds the bed.

The specifications of the machine are as follows:

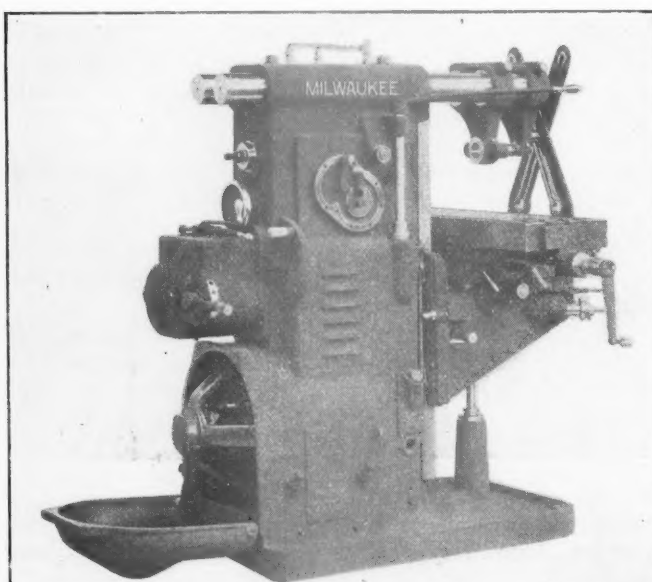
Drilling capacity in steel, 5 in.; swing, 36 in.; working surface of the table, 28 in. by 173 in.; vertical travel of the spindle 18 in.; maximum distance, the nose of the spindle to the table, 30 in.; eight speeds and six feeds for each spindle; taper in spindle, Morse No. 6; motors, two 15-hp., constant speed, to run at 1,200 r.p.m. The motors are not part of the regular equipment. The net weight of the machine is 35,000 lb.



Colburn two-spindle, locomotive rod-boring machine

Milling machine with the motor in the base

REALIZING that the modern tendency in machine design is to make each tool a simplified, compact unit, the Kearney & Trecher Corporation, Milwaukee, Wis., has added to its list of milling machines one which contains the motor drive in the base of the machine.



Milwaukee milling machine with the motor in the base

This feature utilizes the space in the lower part of the column and puts the motor out of the way, protecting it from dirt and dust. It also gives a quieter, more compact and economical installation, and follows the trend of the individual motor driven machine.

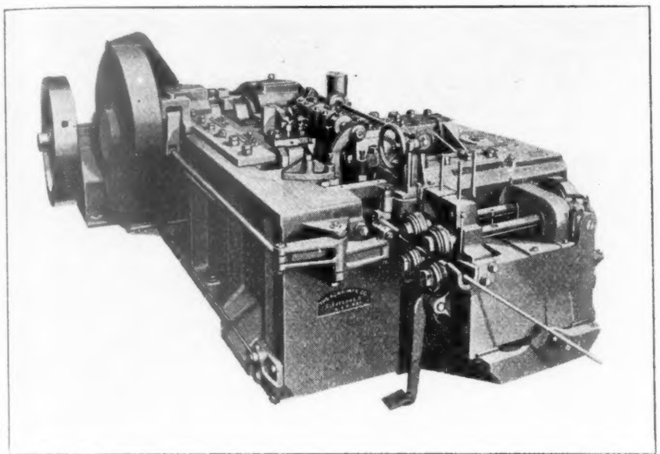
A direct geared drive, using no chain or belts is used. The driving pinion, mounted on the armature shaft, meshes directly with the driving gear leading up through the gear train in the column. The motor is placed with the driving pinion toward the front of the machine. In this position the brushes and commutator can be reached by removing the hinged cover at the rear of the column. The entire motor can be quickly slid out of its housing if any adjustments or repairs are required. Lubrication of the motor bearings are taken care of from the outside of the machine.

The drive is through a newly designed friction clutch, with the control lever extended and brought out to the front of the machine. This control lever may be adjusted to any angle desired for the convenience of the operator, or may be swung completely out of the way for very large work.

Another improvement consists of a new built-in power rapid traverse for the table. Table movements are readily controlled without any chance of confusion. A lever directly at the front of the table engages the table power feed in a direction determined by the lever movement. A second lever, conveniently located to the right hand of the operator as he stands in a normal operating position, may be shifted to change the table movement from the feed to the power rapid traverse rate. The levers are separated and the movements cannot be confused. Other levers controlling the engagement of cross and vertical feeds are located in convenient positions and completely separated from the table control levers. The other features common to the manufacturer's other millers remain unchanged, including an all-geared drive, automatic lubrication of column gearing, double overarm, etc. While this type of machine may be considered as particularly adapted to manufacturing rather than tool needs, it is built for toolroom accuracy and therefore can be used for this service.

Automatic bolt and rivet heading machine

A CONTINUOUS motion bolt and rivet making machine which is designed for either hand or automatic feed and belt or motor drive has recently been developed by The Ajax Manufacturing Company, Cleveland, Ohio. The general arrangement has been improved by transferring the die-slide operating mechanism from the left to the right hand side, making it possible for the operator to feed the stock, watch the quality of the bolts or rivets as they come through the discharge port on the left, and adjust the stock gage all from one position. This arrangement leaves the left side of the machine clear, materially expediting the setting of the dies and tools.

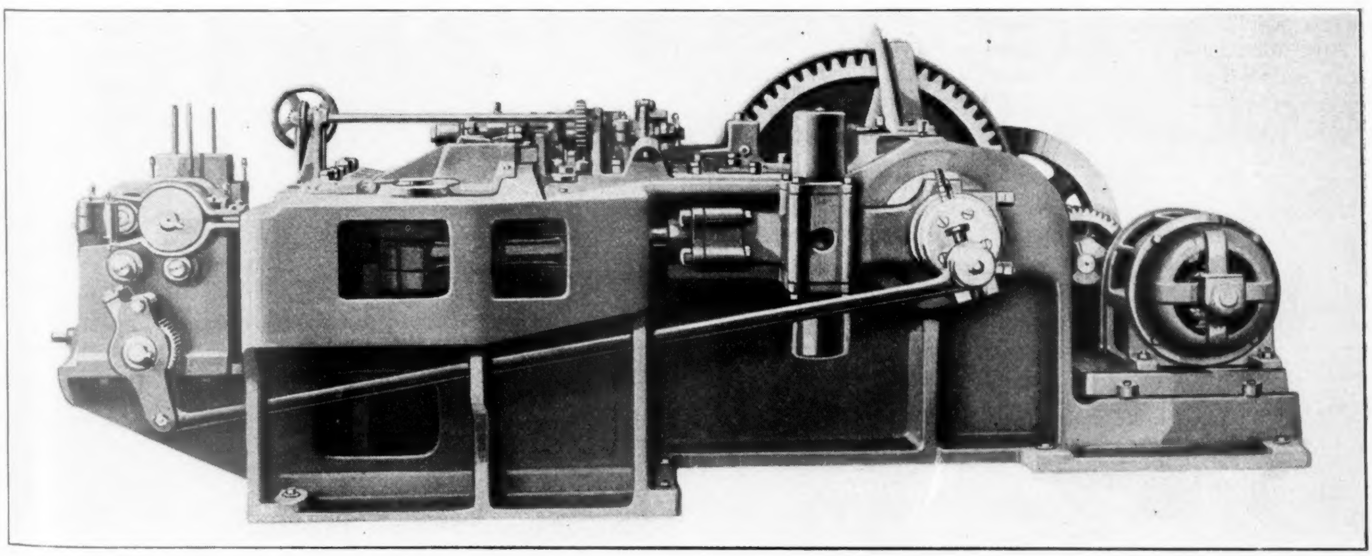


Automatic roll feed, motor driven, heavy duty, continuous motion heading machine

With the hand feed machine, rods heated to four or five feet in length are fed into the machine against the stock gage by the operator by hand, the machine shearing off a blank, heading and ejecting it. Outputs range from 14,000 to 18,000 counts every 10 hours. With the automatic roll feed, mill length rods are heated in a long furnace set about three feet from the front of the machine. The operator need only start the rod into the rolls, which feed it into the machine so that a piece is produced on each revolution. Outputs vary from 30,000 to 50,000 counts every 10 hours, depending on the length and size of rivets produced. The automatic roll feed mechanism is operated from an adjustable crank pin at the end of the crankshaft. The eccentricity of this pin is changed by means of an adjusting screw so that the rolls feed the correct amount of stock to produce any given length bolt or rivet.

The gears of this mechanism are completely enclosed in the feed housing. The ratchet arm is fitted with two dogs, staggered to give refinement of feed. The feed rolls which carry the heated bar stock consist of rings with the circumference grooved to suit the various sizes of stock. They are mounted in holders on the roll shafts so as to be easily changed for different sizes of stock and adjusted laterally for different shear center distances. The roll pressure is controlled by removable weights mounted on the bearings of the upper roll shafts which are movable vertically. In case of a sticker the feed can be stopped and locked out by depressing the foot pedal. An adjustment of distance between the feed rolls and the backing plate reduces waste from crop ends to a minimum. Finished pads on the front of the hand feed machines make it possible to attach this automatic roll feed mechanism at any time.

The belt driven machines are not geared, the flywheel being mounted directly on the end of the crankshaft. A clutch countershaft is provided as a standard accessory with all belt driven machines. Motor drive by direct gearing is provided for by extending the main bed casting to the rear to carry the pinion shaft and motor. A safety friction clutch coupling between this shaft and the main drive pinion cushions the motor from shocks and protects both the machine and the motor from damage should anything prevent a complete revolution of the crankshaft. The steel bed is of the ribbed type with continuous housings for the crankshaft bearings. It is extremely heavy and its deep sections and liberal flanges make it so rigid between crankshaft and backing plate, that it is not necessary to pack up excessively behind the



Automatic roll feed mechanism attached to the machine, showing the adjustable crank pin, the feed rod, the ratchet arm and the roll housing

heading tool to bring rivet or bolt heads down to the proper thickness. All wearing surfaces are suitably bushed and lined so that there is no direct wear of moving parts on the bed proper.

The header slide is top-suspended from V-type bearings. The trough ways of the bed, in which the header-slide bearings operate, are above the scale line. They are roll lubricated from two reservoirs and drain at the front, so that good lubrication with clean oil is maintained. The bearings on the header-slide and the ways in the bed are both removable for re-alinement. The die slide is top-suspended from plain bronze-faced bearings. A wedge liner on the crankshaft side, adjustable without removing any parts, makes it possible to keep the moving die back tight on the cutter, so as to shear the stock squarely. The self-adjusting side arm relief of the die slide actuating mechanism fully protects the machine in case a bolt or rivet lodges in or is caught between the faces of the dies. As soon as the obstruction is removed, the side arm automatically resets itself. The ejector is of the walking beam type operated from a cam on the inside of the flywheel. The cam is adjustable to control the time of kick-out and to offset any wear.

The stock gage can be adjusted by means of the hand wheel while the machine is running. The hand wheel is convenient to the operator as he watches the product being headed so that adjustments can be made quickly, for a slight variation in the stock diameter so that all heads will be properly filled out. The cam on the header-slide which actuates this gage is adjustable to change the timing for different shear center distances. Three types of gage arms are furnished for use when making short, medium and long rivets.

Both hand and automatic feed machines operate on the same principles so far as the heading mechanism is concerned. The heated bar is advanced through the breast plate until it strikes the stock gage which is so set that just enough of the bar projects through the breast plate to make a finished rivet. The moving die then travels across the breast plate shearing off the blank on the cutter, and gripping it against the stationary die. The header-slide moves forward, a cam on the top swings the stock gage out of the way and the heading tool in the toolholder heads the stock which projects from the dies, against the face of the dies. The heading tool then backs off and the dies open, whereupon the headed piece is kicked out of the dies by the ejector and drops out through the discharge port, completing the cycle. Water from overhead pipes is directed into the dies and the heading tool to keep them cool and carry away scale.

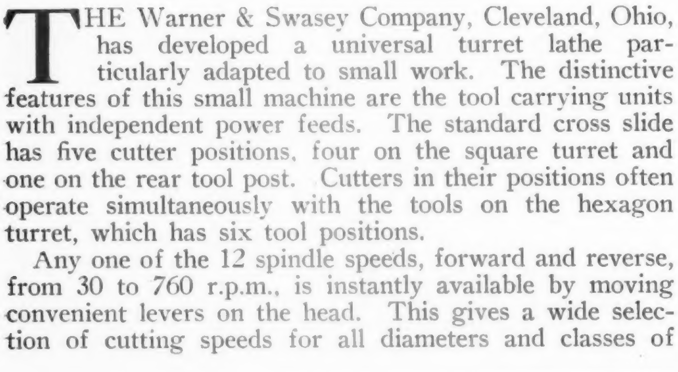
The power of the motor required is from 7½ to 20 hp. for machine sizes varying from ¾ in. to 1½ in. in the case of hand feed, and from 10 to 30 hp. for the same sizes in the case of automatic feed.

All geared head universal turret lathe

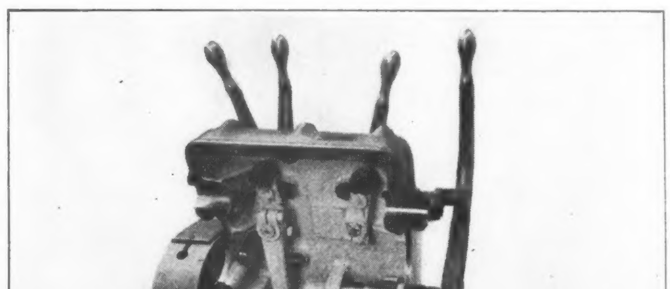
THE Warner & Swasey Company, Cleveland, Ohio, has developed a universal turret lathe particularly adapted to small work. The distinctive features of this small machine are the tool carrying units with independent power feeds. The standard cross slide has five cutter positions, four on the square turret and one on the rear tool post. Cutters in their positions often operate simultaneously with the tools on the hexagon turret, which has six tool positions.

Any one of the 12 spindle speeds, forward and reverse, from 30 to 760 r.p.m., is instantly available by moving convenient levers on the head. This gives a wide selection of cutting speeds for all diameters and classes of work. The hardened gears run in oil and provision is made for easy adjustment of the frictions. The wide range of speeds and power of the all geared head enables this machine to pull stellite cutters to their capacity. It also makes possible the combining of a greater number of cutters to operate at the same time.

The machine is well suited to individual motor drive. The motor may be mounted at the rear of the machine or on the head-end leg, driving to the pulley by means of a belt. Where it is necesary to conserve floor space, the motor can be mounted on the head. The machine, when arranged for motor drive, may be placed where con-



Warner & Swasey No. 4 universal turret lathe



Turret lathe with all geared head giving 12 spindle speeds

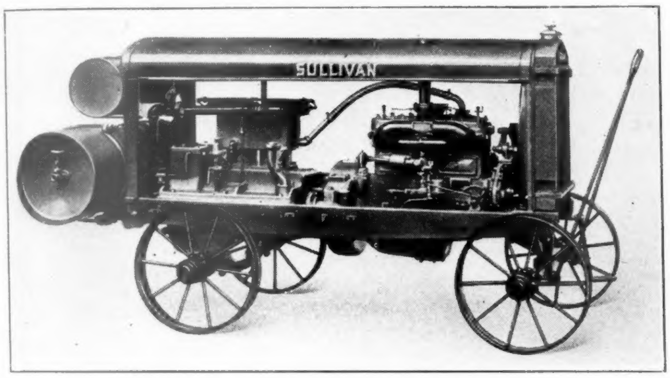
venient regardless of line shaft conditions. Waste space can often be utilized in this way, and if changes require moving, the machine may be quickly transferred.

Over seventy-five standard small tools are carried in stock for this machine. These tools greatly increase the productive possibilities of the turret lathe for all classes of work, and reduce the cost of tooling. The machine is claimed to be rapid in operation, easily handled and quickly tooled. It is, therefore, suitable not only for quantity production, but for use in the repair shop and the tool room where only a very few pieces are made at one time. The tooling is easily adjusted from one job to another and the twelve spindle speeds readily provide the right surface speeds for economical cutting.

The lathe is designed to be equally efficient for bar and chucking work. Round bars up to 1½ in. in diameter can be chucked through the automatic chuck. Ten inches is the maximum length which can be turned at any one setting of the turret saddle along the bed. For chucking work, a geared scroll chuck holds the piece. The maximum swing over the ways is 16 in. and over the carriage guides, 14¼ in.

Portable motor driven air compressor

THE rapid increase in the application of compressed air in railway practice, especially where the air cannot be readily piped, has called for the development of portable air compressors in a great variety of types and capacities. The machine shown in the illustration is a 103-cu. ft. gasoline engine driven, portable unit developed by the Sullivan Machinery Company, Chicago.



Sullivan portable, gasoline engine driven air compressor

The compressor is directly connected to a Buda, four cylinder, four cycle gasoline engine, and as stated, has a rating of 103 cu. ft. per min. against 100 lb. pressure, requiring 17 hp. for this duty. The compressor is a vertical, two cylinder, single acting, single stage unit, designed especially for this service. Lubrication is automatic and the cooling water for the engine and the compressor are supplied by a circulating pump in the same system. The air valves are the Sullivan "wafer" type, characterized by simplicity, strength, low clearance losses and quietness in action. The compressor, engine and equipment are mounted on a one-piece steel casting of rigid construction. The 12-gal. gasoline tank and the 18-in. by 48-in. air receiver are carried horizontally in cradles at the rear of the truck body, and all working parts of the compressor are protected, when not in use, by sheet steel sides which are locked in place against the base and the steel canopy top, thus protecting the outfit from the weather and from the theft of equipment.

This machine is mounted on a steel wheel truck and weighs 3,235 lb. in this form.

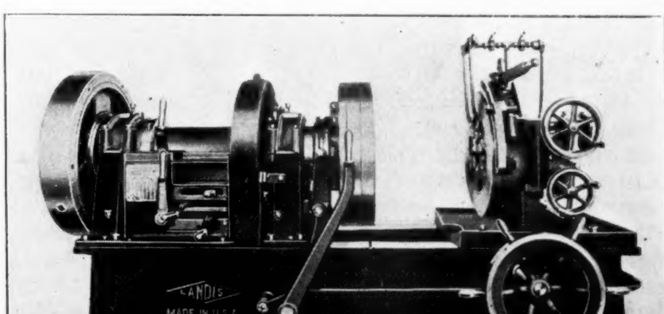
A six-inch pipe threading and cutting machine

A PIPE threading machine with a range from one inch to 6 in. has been added to its line by the Landis Machine Company, Waynesboro, Pa. Two die heads are employed for covering this range; one 2-in. head for a range from 1 in. to 2 in. inclusive, and a 6-in. head for a range from 2½ in. to 6 in. The entire range of each head is covered by one set of chasers. The travel of the carriage is 22 in. and has eight speeds. The speed of the 14-in. driving pulley is 300 r.p.m. The machine is 9 ft. 8 in. in length by 4 ft. 9¾ in. in width and weighs 8,800 lb.

The machine has a geared headstock and a single pulley drive. The variations in speed are obtained by means of a self-contained gear box, located beneath the main spindle. All the gears are cut steel and run in an oil bath. All bushings are bronze. The shaft bearings are lubricated automatically by a forced feed system. The main bearings are lubricated by flat link chains which run in oil contained in large reservoirs.

The front three-jaw chuck has a universal adjustment and is lever operated which permits the gripping and releasing of the pipe while the chuck is in motion. A universal geared, three-jaw chuck is employed at the rear of the machine and is fitted with flange grips for screwing flanges on and off. A reverse drive is obtained by a shifting lever for this operation.

The cross rail supports the die head, and is also fitted with cutting-off and reaming tools and a length gage. The die lubricating system includes a rotary pump, a by-



Operating side of the Landis 6-in. pipe threading and cutting machine

pass for the surplus oil and a special control valve at the head and cutting-off tools. All levers are located on the operating side of the machine in convenient reach for the operator.

This machine is very easily adapted to motor drive which can be applied after the machine is in service. The motor is mounted on a plate over the gear box and a silent chain transmits the power from the motor to the machine. A 7½-hp. constant speed motor, wound for an approximate speed of 1,200 r.p.m. is recommended which enables the machine to be operated at its maximum efficiency whenever desired.

The Landis stationary die head and long life tangential chaser is used on this machine.

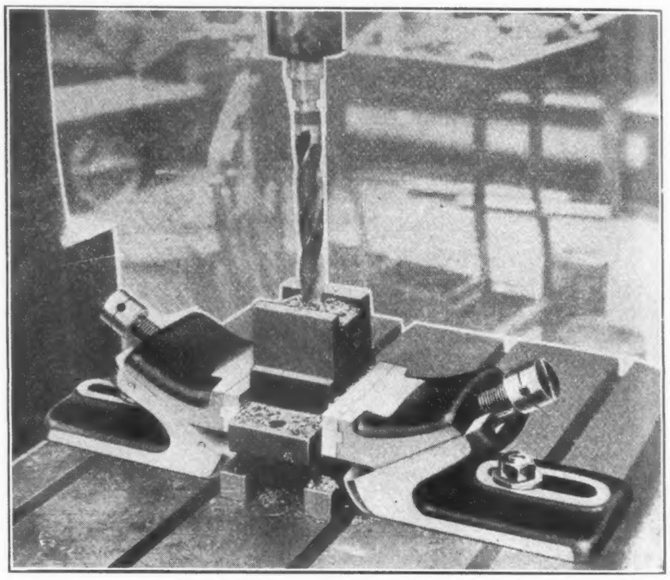
Coats divided machine vise

It is not an uncommon sight in a railway shop to see a mechanic trying to set up on a machine an irregular shaped piece of work with all kinds of bolts, packing pieces, straps and wedges, because it is impossible to hold it in the machine vise. The Coats Machine Tool Company, New York, has developed a divided machine vise which apparently overcomes this difficulty. It is designed to hold parallel, tapered or irregular work. It combines adjustability in height with an unlimited span and beds the work truly on its supports, because of the compound parallel and downward movement of the jaws, eliminating the use of a hammer.

The body and jaws of the vise are made of close grain cast iron. The jaws are faced with hardened steel with serrated surfaces to insure a good grip. The screws are of steel and have right and left-hand threads, the left-hand thread running in a solid nut on the moving jaw, and the right-hand in the nut which is secured to the body. For each revolution of the screw, therefore, a movement of the jaws is obtained equal to twice the pitch of the screw, thus resulting in double action. The jaw is fitted to the body in V-guides, properly fitted, and an adjustable steel gib and screws furnish the necessary adjustment for wear.

They can be used either singly or in pairs, or three, four or more at a time may be employed for clamping irregular shapes. The jaws may be placed in any off-set position required by the shape of the work. Their main field of usefulness is on the tables of milling, drilling, shaping, slotting and planing machines which may be found in all railway shops.

The vises are made in three sizes, the width of the jaw ranging from 2½ in. to 10 in. and the diameter of the



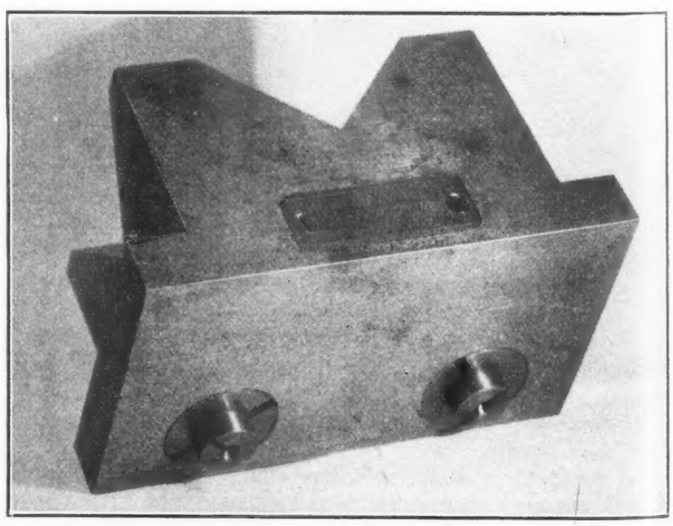
Divided machine vice for holding any irregular piece of work

screw from ½ in. to 1½ in. The approximate weight per pair is 6 lb., 40 lb. and 220 lb., respectively, which takes care of all sizes of irregular work.

Crescent V-type work support

The use of V-blocks has always proved a time-saving device on lay-off tables and on all types of machines. A useful type of V-block has recently been designed by the Crescent Engineering Company, Baltimore, Md. It is made of close grained, grey iron and machined accurately to within .001 in. The base is fitted with two ⅝-in. tool steel, hardened and ground pins, operating in steel bushings. They can be locked up or down as desired, and can be changed in a few seconds with the use of a screw driver. The pins on the support shown in the illustration are off center which is very desirable as it enables the operator to use the block partly overhanging a machine edge, and still have sufficient base for clamping solidly.

With the pins extended, the tool can be used in connection with the service slots of any machine for quick alinement with the spindle or table travel. With the pins screwed up in the block, it can be used anywhere as a regular V-block. It has suitable clamping flanges and is made in three sizes.



V-type work support provided with clamping flanges

General News

The suggestion plan placed in effect by the Missouri Pacific last August, under which its employees are encouraged to submit plans for bettering shop practices, has been accorded the enthusiastic support of employees throughout the system. Under the plan the employees elect production and executive committees to pass upon the suggestions submitted. At Sedalia, Mo., where the suggestion plan first went into effect, approximately 90 per cent of all those employed at the Sedalia shops indicated their interest by casting ballots for members of the committees.

Howell-Barkley bill again passed by

A fourth day on which the Howell-Barkley railroad labor bill might have been considered in the House of Representatives was allowed to pass by on January 19 without any effort being made by the advocates of the bill to have it taken up. The bill is on a House calendar that comes up only every other Monday but so far at this session of Congress no effort has been made to have the bill considered. The Senate committee, having reported the bill with an amendment, is giving it no further attention, although some of the advocates of the bill say they are still hoping to have the amendment put in a more desirable form.

General Atterbury becomes mechanical division representative on A. R. A. board

According to the articles of organization of the American Railway Association, a member of the board of directors is to be selected by the board to represent it in the work of each division and, in effect, to represent the division on the board of directors of the parent association. The members of the board so selected form the Executive Committee.

At a meeting of the board of directors held on January 6, Gen. W. W. Atterbury, vice-president of the Pennsylvania System, was elected to succeed W. B. Storey, president of the Atchison, Topeka & Santa Fe, as Mechanical Division representative. Mr. Storey has served in this capacity since the establishment of the present form of organization of the A. R. A.

Mr. Atterbury is succeeded as the representative of the work of Division 1—Operating, by Carl R. Gray, president of the Union Pacific System, the newly elected member of the Executive Committee. H. E. Byram, president of the Chicago, Milwaukee & St. Paul, is also a newly elected member of the Executive Committee, representing Division VII—Freight Claims, which, until his selection, had been without Executive Committee representation. The complete list of division representatives is as follows:

Division I..........	Operating, C. R. Gray, president Union Pacific System.
Division II..........	Transportation, E. J. Pearson, president, New York, New Haven & Hartford.
Division III..........	Traffic, C. H. Markham, president, Illinois Central.
Division IV..........	Engineering, J. Kruttschnitt, chairman, Southern Pacific.
Division V..........	Mechanical, Gen. W. W. Atterbury, vice-president, Pennsylvania System.
Division VI..........	Purchases and Stores, W. G. Besler, president, Central of New Jersey.
Division VII..........	Freight Claims, H. E. Byram, president, Chicago, Milwaukee & St. Paul.

Wage statistics for October

In the month of October, 1924, the employment on Class I railroads reached the highest point since November, 1923, according to the Interstate Commerce Commission's monthly bulletin of wage statistics. The total number of employees reported was 1,822,616, an increase of 21,320 or 1.2 per cent over the number reported for September, 1924. The total compensation increased $14,825,589 or 6.2 per cent. The ratio of increase in the compensation is greater than the ratio of increase in employment because of the fact that October had 27 working days while September had only 25.

Compared with the corresponding month last year, the employment in October, 1924, decreased 5.9 per cent and the total compensation shows a decrease of 5.7 per cent.

Labor news

SHOP EMPLOYEES of the Delaware, Lackawanna & Western have finally called off the strike which has been effective since July 1, 1922. The Lackawanna has issued a statement that the men will not be given their old jobs back but will have to apply for work as new men.

THE GULF, COLORADO & SANTA FE has negotiated an agreement with the engine service employees similar to that made by the Southern Pacific which grants wage increase of approximately six per cent and changes a few minor working rules. The Atchison, Topeka & Santa Fe, Eastern, Western and Coast Lines, are now meeting the representatives of Brotherhood of Locomotive Engineers and Brotherhood of Locomotive Firemen and Enginemen to reach agreements affecting the employees of those lines. The Terminal Railroad Association of St. Louis has also signed an agreement with engine service brotherhood on the Southern Pacific basis, calling for the wage increase without changes of working rules.

LABOR BOARD REPORTS ON DECISIONS RENDERED.—In a report furnished to the congressional appropriations committee, the railroad labor board announced that it had rendered 706 decisions during 1924, of which 333 favored the railways; 323 favored the employees and 50 either decided nothing or decided partly for the managements and partly for the employees. Most of the organizations, with the exception of the four train and engine service brotherhoods, were given a majority of the favorable decisions on disputes in which they took part.

WESTERN PACIFIC WAGE INCREASE FOR ENGINEMEN.—The Western Pacific has made an agreement on wage increases with its engine service employees, represented by the Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen and Enginemen, similar to that made by the Southern Pacific with its enginemen. The agreement awarded a wage increase of approximately six per cent to the men without changes of working rules. Like the Southern Pacific, the Western Pacific was one of the roads which were parties to the recent dispute before the Railroad Labor Board, in which the board approved the wage advance only on condition that certain burdensome working rules be amended.

C. & S. UPHOLDS DECISION IN ENGINEMEN'S WAGES.—Demands of the Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen & Enginemen, that the engine service employees of the Colorado & Southern receive a six per cent wage increase without changes in working rules, have been flatly refused by W. P. Hayden, assistant general manager of the Colorado & Southern. He declared that the Colorado & Southern would stand squarely behind the decision of the United States Railroad Labor Board which granted the wage increase only on condition that the brotherhoods accept changes in some of the more burdensome rules. Although negotiations are continuing and no strike vote has been taken, the brotherhoods are expected to take the same action on the Colorado & Southern as they took on the Southern Pacific to enforce compliance with their demands. On the Southern Pacific an overwhelming majority of the employees are said to have voted to strike if the agreement they had proposed was not approved by the management.

AN AGREEMENT CALLING for a wage increase of approximately six per cent without changes in important working rules, similar to that made on the Southern Pacific, has been approved by the Chicago & North Western and its engine service employees represented by the Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen and Enginemen. Although the North Western was one of the roads involved in the recent Labor Board decision which granted the wage increase to the

enginemen only on condition that they accept a number of changes in important working rules, it followed the example of the Southern Pacific and the Western Pacific in not insisting that this decision be made the basis of an agreement. The policy of the brotherhoods has been to ignore the board's decision and to force agreement to their demands of wage increases without changes in working rules through negotiations with individual managements in which strike threats are freely made. So far as is known, no railway has succeeded in making an agreement with its engine service employees on the basis of the Labor Board's decision, although one road, the Colorado & Southern, is known to have insisted that it will make no agreement on any other terms.

POWER OF LABOR BOARD AGAIN UPHELD.—The right of the United States Railroad Labor Board to compel witnesses to appear and testify before it, was upheld for the second time by Federal Judge Wilkerson of the United States District Court at Chicago on January 12. The suit was brought by the Labor Board against J. Maguire, chairman on the Chicago & North Western of the Brotherhood of Locomotive Engineers, who refused to testify in the board's hearing of the dispute between the western railways and their engine service employees. In spite of the fact that the representatives of the employees did not testify at the board's hearing, a decision on the dispute was rendered sometime ago, awarding a wage increase of six per cent to the employees on condition that they accept a number of changes in working rules.

The Labor Board had previously won a similar decision in the United States court in the case of D. B. Robertson, president of the Brotherhood of Locomotive Firemen and Enginemen. As was done following the court's ruling on the Robertson case, counsel for Mr. Maguire will appeal Judge Wilkerson's decision. The Robertson case is now pending in the United States Supreme Court.

The brotherhoods took the position that the Labor Board's orders had been held unenforceable by the United States Supreme Court and that it was a mere arbitrary body without power to compel testimony. They also charged that Ben W. Hooper, chairman of the board, was prejudiced against them.

"The Labor Board does not act as an arbitrator in the proper sense of the word but as an administrative body," said Judge Wilkerson in considering these contentions. "Its acts, if arbitrary, are void. Whether its acts are arbitrary is to be determined, not by the state of mind of one of the members, but by the acts themselves." Judge Wilkerson declared that in his opinion the proposed compulsion of testimony does not violate the fifth amendment of the constitution and that the interest of a witness in a dispute does not preclude the board's making him testify in connection with it.

Meetings and Conventions

General Foremen's Association

The International Railway General Foremen's Association has appointed committees to report on the following topics at the annual convention in Chicago next September.

Automatic train control—Charles C. Kirkhuff, Atchison, Topeka & Santa Fe, Chicago, chairman.

Supervision and repairs of special appliances, boosters, reverse gears, feedwater heaters, etc.—J. H. Armstrong, Atchison, Topeka & Santa Fe, Topeka, Kans., chairman.

Straight line or spot system of car repairs—G. P. Hoffman, Baltimore & Ohio, Baltimore, Md., chairman.

What can the general foreman contribute to obtain more ton-miles per shop man-hour?—F. B. Harmon, Atchison, Topeka & Santa Fe, San Bernardino, Cal., chairman.

Reclamation of material, car and locomotive—A. J. Larrick, Baltimore & Ohio, Chillicothe, Ohio, chairman.

Best routing system to increase shop output—Wallace Murray, Chicago, Rock Island & Pacific, Silvis, Ill., chairman.

Additional information may be obtained from the secretary-treasurer of the association, William Hall, Winona, Minn.

An appreciation of Secretary Kline

The January meeting of the Car Foremen's Association of Chicago was held at the Great Northern hotel on Monday evening, January 12. The first part of the meeting was devoted to a discussion of the new A. R. A. rules under the direction of the association's committee on that subject. The latter part of the meeting was given over to a celebration of the twenty-fifth anniversary of the election of Aaron Kline as secretary of the association. Mr. Kline was given a rising vote of thanks for his faithfulness and effective work in increasing the association's membership and influence among railroad car foremen, car inspectors and other car department employees. Instead of making Mr. Kline some gift in token of his long and faithful service, the board of directors voted to grant him an increase of salary as a more effective way of showing their appreciation. Photographs of past presidents were posted around the walls of the meeting room and Mr. Kline received personal letters of appreciation from all living past presidents.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next meeting May 5-8, Los Angeles, Cal.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Business meeting to be held in Chicago during week commencing June 15. No exhibit of railway supplies and machinery will be held.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division. A. F. Steubing, Bradford Corp., 25 West Forty-third street, New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting February 10. Paper will be read on Foundation Brakes, by W. H. Clegg, chief inspector, air brakes and car heating equipment, Canadian National, Montreal.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Next interim meeting February 12. Paper on "Locomotive Feed Water Heating," will be presented by L. G. Plant, assistant to the president, National Boiler Washing Company, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November. Next meeting February 10. Paper on "Three Cylinder Locomotives" will be read by Perry T. Egbert, representative, American Locomotive Company. Illustrated by moving pictures.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland. Next meeting February 2. Discussion of A. R. A. Rules.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention, Hotel Winton, Cleveland, Ohio, August 18, 19 and 20.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill. Next annual convention May 26-29, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash St., Winona, Minn.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Next convention May 19-25, Hotel Sherman, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting February 10. Methods of Analyzing Shop Output and Costs will be discussed by J. E. Slater, special assistant to general manager, New York, New Haven & Hartford.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Next meeting February 13. Moving picture entitled, "Oxygen, the Wonder Worker," produced by the United States Bureau of Mines in connection with the Air Reduction Company, will be shown. Oxy-acetylene application will also be demonstrated.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

TRAVELING ENGINEER'S ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September, 1925, Chicago.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 189 West Madison St., Chicago. Meetings third Monday in each month, except June, July and August. Annual meeting May 23, Edgewater Beach Hotel, Chicago.

Supply Trade Notes

Henry W. Jacobs, formerly president of the Oxweld Railroad Service Company, Chicago, died on January 6 in Chicago.

The United Alloy Steel Corporation plans the construction of two one-story brick and steel factory buildings at Canton, Ohio.

William S. Estell, who retired as secretary of the Adams & Westlake Company, Chicago, in 1923, died on January 4 in Chicago, of pneumonia.

John Heller, for a long time one of the directors of the International Oxygen Company, Newark, N. J., has been appointed sales manager.

The McMyler-Interstate Company, Cleveland, Ohio, has removed its Detroit office from 1701 Washington Boulevard building to 1156 Book building.

Glenn G. Howe, for many years senior vice-president of the Link-Belt Company, Chicago, died at his home in Muskegon, Mich., on December 25.

The DeVilbiss Manufacturing Company, Toledo, Ohio, has opened an office and display room at 1006 Republic building, State and Adams streets, Chicago.

The Truscon Steel Company, Youngstown, Ohio, is contemplating the erection of a one-story factory branch and district plant at Jacksonville, Fla., to cost approximately $25,000.

O. D. Hays, district manager of the Oxweld Railroad Service Company, with headquarters at Atlanta, Ga., has been transferred to the Southwestern district, with headquarters at St. Louis, Mo.

Daniel O'Rourke, superintendent at the east portal of the Moffet tunnel, has been appointed special representative of hammer drills of the Sullivan Machinery Company, with headquarters in Chicago.

E. J. Costello, Jr., representative of the Truscon Steel Company, with headquarters at Pittsburgh, Pa., has been appointed sales engineer in the railroad department, with headquarters in New York.

The St. Louis Forgings Company, a subsidiary of the Standard Forgings Company, Chicago, has purchased the forging plant of the Laclede Steel Company, East St. Louis, Ill., and plans to expand the new plant.

O. L. Chapman has joined the sales organization of the Scott Valve Manufacturing Company, Detroit, Mich. Mr. Chapman will devote his time to the application of valves to manufacturing plans and similar lines of industry.

The business heretofore conducted under the name of the Franklin Railway Supply Company of Canada, Ltd., Montreal, Quebec, will be continued under the same management in the name of the Franklin Railway Supply Company, Ltd.

William P. Kirk, district manager of sales of the Niles-Bement-Pond Company, with headquarters at Cincinnati, Ohio, has been transferred to New York and will be succeeded by E. H. Gates, manager of Rochester, N. Y., branch office.

The Wanner Malleable Castings Company has been organized under the laws of Delaware with a capitalization of $1,850,000 and will take over and expand the plant and business of the Wanner Malleable Castings Company at Hammond, Ind.

Joseph W. Irwin, until recently president of the Mitchell Spring & Manufacturing Company, Johnstown, Pa., has resigned to become connected with his former associates as general superintendent of the Fort Pitt Spring & Manufacturing Company, Pittsburgh, Pa.

D. Maxwell, district manager of the Williams Tool Corporation, with headquarters at Chicago, has been transferred to Cleveland, Ohio, and will be succeeded by William J. Eberlien, store manager of the Greenfield Tap & Die Corporation, with headquarters at Chicago.

Henry W. Darling, for more than 30 years treasurer of the General Electric Company, Schenectady, N. Y., has resigned, and has been succeeded by R. S. Murray, who had been assistant treasurer of the company since 1910. In accepting the resignation of Mr. Darling as treasurer, the board of directors elected him a vice-president, with such duties as shall be assigned to him by the president.

A. E. Huckins, vice-president of the Burr Company, engineers, founders and machinists, specializing in the manufacture of dynamometer apparatus for railways, with headquarters at Champaign, Ill., has resigned. This company has also discontinued its Chicago office.

William H. Utz, vice-president and formerly European director of Jenkins Bros., Limited, with headquarters at London, England, has been appointed director of sales of Jenkins Bros., valve manufacturers, New York. Mr. Utz will have general charge of the selling activities of the company.

E. P. Essley, secretary of the E. L. Essley Machinery Company, Chicago, has taken over the duties of sales manager, formerly carried on by James J. Shanahan, general manager, resigned. Other departments of the general manager will be under the direct supervision of E. L. Essley, president.

C. T. Knissely, president of the Knissely Brothers Manufacturing Company, manufacturers of hollow metal fireproof doors and window sills, has been appointed sales manager of the Railway Brakeshoe & Foundry Company, with headquarters in the newly opened office, 5 South Wabash avenue, Chicago.

Col. Eugene C. Peck, who has served for almost 25 years as general superintendent and later as works manager of the Cleveland Twist Drill Company, Cleveland, Ohio, has retired from active management. He will continue, however, as a stockholder in the company and as a member of the board of directors.

The Brown & Sharpe Manufacturing Company, Providence, R. I., at a recent meeting of the stockholders, elected the following officers: William A. Viall, Henry Buker and Paul C. DeWolf, vice-presidents; John A. Cave, secretary; John Sharpe Chafee and Richmond Viall, assistant secretaries. Henry D. Sharpe continues to hold the office of president and treasurer.

Lawrence Richardson, sales engineer of the Whiting Corporation, Harvey, Ill., and Col. C. H. Crawford, general representative of the Baldwin Locomotive Works in Brazil, with headquarters at Rio de Janeiro, have joined the Dwight P. Robinson Company, Inc., New York. Mr. Richardson will be located in New York for about a month until definite plans are formed.

Ambrose N. Diehl, general superintendent of the Duquesne Works of the Carnegie Steel Company, has been elected a vice-president in charge of operations in the Pittsburgh district, with headquarters at Pittsburgh, Pa. J. Lamont Hughes, general superintendent at Youngstown, Ohio, has been elected a vice-president in the Youngstown, Ohio River and Valley district; Samuel G. Worton, assistant superintendent, succeeds Mr. Diehl, and David C. Burroughs, superintendent of the electrical department, has been appointed assistant general superintendent at the Duquesne Works.

The Associated Machine Tool Dealers has been organized by manufacturers and dealers in machine tools to promote a closer relationship and co-operation between manufacturers and dealers. Officers of the new organization are: president, G. E. Merryweather, of the Motch & Merryweather Machine Company, Cleveland, Ohio; vice-president, Marshall Prentiss, of Henry Prentiss & Company, New York; secretary, T. W. Carlisle, of the Strong, Carlisle & Hammond Company, Cleveland; and treasurer, G. H. Cherrington of the Brown & Zortman Machinery Company, Pittsburgh, Pa.

Francis C. Pratt, vice-president in charge of engineering of the General Electric Company, has been appointed to fill the vacancy caused by the resignation of G. E. Emmons, as vice-president in charge of manufacturing and chairman of the manufacturing committee. Mr. Pratt's new title will be vice-president in charge of engineering and manufacturing. H. F. T. Erben has been appointed assistant vice-president on the staff of Mr. Pratt. He will continue as vice-chairman of the manufacturing committee. Mr. Pratt's engineering assistant is E. W. Allen, appointed to the position of manager of the engineering department in April, 1924.

S. D. Hutchins, representative of the Westinghouse Air Brake Company at Columbus, Ohio, died on January 5 in the Mt. Carmel Hospital, following an operation. Mr. Hutchins was born at Cleveland on May 25, 1855. He entered the service of the Springfield, Mt. Vernon & Pittsburgh, now a part of the Cleveland, Cincinnati, Chicago & St. Louis, in 1871, as a fireman, and was promoted to

engineman in 1873. On May 15, 1896, Mr. Hutchins entered the service of the Westinghouse Air Brake Company as assistant on its air brake instruction car, and in 1905 was promoted to the position of representative, with headquarters at Columbus, which position he held until his death.

E. B. Perry, vice-president and general manager of the Industrial Works, with headquarters at Bay City, Mich., has been elected president and general manager to succeed W. L. Clements who has been elected a member of the board of directors. H. H. Perry, assistant to the vice-president and general manager, has been promoted to manager. C. R. Wells, secretary and treasurer, has been elected a member of the board of directors and will be succeeded by N. D. Platt, office manager, who in turn will be succeeded by J. L. Trudell, advertising manager, who will be succeeded by A. R. Olson. Walter Perry, superintendent, has been promoted to general superintendent.

The business of the T. H. Symington Company, manufacturers of railway equipment, has been conducted by a new corporation since December 17, 1924, organized under the laws of the State of Maryland, known as the Symington Company. The reorganization involves merely a readjustment of capital coincident with the placing of Charles J. Symington, who for five years was president of the T. H. Symington Company, in complete control of the policies of the new company. Including the election of Donald Symington, first vice-president; J. A. Sauer, vice-president, and P. P. Meade, secretary-treasurer, all with offices in New York, the same management of the old company continues. LeRoy Kramer, vice-president, remains in charge of western sales, with headquarters at Chicago, and Robert H. Gwaltney, vice-president, remains in charge of eastern and southern sales, with headquarters at New York. The operation of the Symington Company's works at Rochester, N. Y., will continue in charge of Donald S. Barrows, operating vice-president.

Safford S. DeLano, treasurer of the American Car & Foundry Company, New York, died at his home, 137 Riverside Drive, New York City, on December 27. Mr. DeLano was born in Waverly, N. Y., on January 24, 1856, and received his education in the public schools of Towanda, Pa. He entered the employ of the Michigan Car Company, Detroit, when sixteen years of age, and was advanced steadily until September, 1892, when a consolidation with the Peninsular Car Company was effected under the name of Michigan-Peninsular Car Company and he was appointed assistant treasurer of the new company. In 1899, upon the formation of the American Car & Foundry Company, the Michigan-Peninsular Car Company entered the consolidation, and in 1900 Mr. DeLano became a director and comptroller. In 1901 he was appointed treasurer, holding that office continuously until his death. He was also a director and treasurer of the American Car & Foundry Export Company and treasurer of the Sligo Furnace Company.

S. S. DeLano

The National Car Wheel Company and the Southern Wheel Company have been merged and are now operating under the name of the Southern Wheel Company, which is a subsidiary of the American Brake Shoe & Foundry Company. The merged company has plants at Pittsburgh, Pa.; Rochester, N. Y.; Cleveland, Ohio; Sayre, Pa.; St. Louis, Mo.; Birmingham, Ala.; Atlanta and Savannah, Ga., and Portsmouth, Va. The general offices are in the Keystone building, Pittsburgh, Pa., and the officers are as follows: W. F. Cutler, president, New York City; Frank C. Turner, first vice-president, Pittsburgh; J. Brookes Spencer, vice-president in charge of sales, Pittsburgh; C. C. Esdale, operating vice-president, Birmingham; C. M. Bower, vice-president, New York City; H. E. McClumpha, operating vice-president, Pittsburgh; J. Francis Weisbrod, assistant vice-president, Pittsburgh; Andrew Muirhead, treasurer, Pittsburgh; W. M. McCoy, controller, New York City; E. C. Hof, assistant controller, Pittsburgh, and G. M. Judd, secretary, New York City.

The Bethlehem Steel Corporation celebrated its 20th anniversary on December 10. During its 20 years of progress the management has adopted a policy, in acquiring new plants, of dividing and subdividing work so that each plant makes special steel products selected in accordance with the layout of the plant, the supply of raw materials and the market for the products. As a result, the corporation has an ingot capacity sixty times greater than it had in 1904 and only eight times as many employees. In 1904 the entire ingot capacity, all of which was in one plant, amounted to 120,000 tons a year, while at the present time the capacity amounts to 7,600,000 tons, distributed among seven steel plants.

George E. Doke, engineer of materials and equipment tests of the New York Central, at New York, has resigned his office and has been elected president of the Association of Manufacturers of Chilled Car Wheels, with headquarters at Chicago, to succeed George W. Lyndon, who died on October 7 in Chicago. George E. Doke was born in Tecumseh, Mich., on August 19, 1877, and was educated in the elementary and high schools of Elkhart, Ind. From 1897 to 1900 he served on the Indiana, Illinois & Iowa (now a part of the New York Central). He also served on the Lake Shore & Michigan Southern as yard clerk, telegrapher, bill clerk and timekeeper. He then entered the shops of the Lake Shore & Michigan Southern as an apprentice, and while serving in this position completed a special course in mechanical drawing and mechanical engineering. In 1905 he entered the chemical and physical laboratory of the Lake Shore & Michigan Southern at Cleveland as a laboratory assistant, becoming chief material inspector of that road's material inspection force in 1906. In 1912 he was promoted to assistant engineer of tests in charge of the locomotive and car department's service tests, and in 1916, following the consolidation of the Lake Shore & Michigan Southern with the New York Central, was promoted to assistant engineer of tests in charge of material inspection for the car and locomotive departments for the New York Central System. Four years later he was promoted to engineer of materials, with headquarters at Cleveland, Ohio, in charge of materials inspection and the creation and development of material specifications, and two months later was made engineer of tests of the New York Central Railroad in New York City, in charge of chemical and physical laboratories, material inspection bureau, service test department and dynamometer car tests. Since 1922 he has served as engineer of materials and equipment tests of the New York Central Railroad, in which position he has had charge of the service test department, dynamometer car tests, examination of failed materials and the creation and development of the equipment engineering department's material specifications. Mr. Doke for several years past has been an active committee member of the American Society for Testing Materials and the Mechanical Division of the American Railway Association. He is also a member of the Cleveland Engineering Society and the American Society of Mechanical Engineers.

George E. Doke

The Okonite Company has opened an office at 310 South Michigan avenue, Chicago, and has taken over the sale of Okonite products in the western territory. Charles E. Brown, vice-president of the Central Electric Company, has been appointed vice-president in charge of the territory west of Pittsburgh and east of the Rocky Mountains of the Okonite Company, with headquarters in Chicago. A. L. McNeill, manager of the railroad department of the Central

Electric Company, has been appointed manager of the railroad department. E. H. McNeill, railroad sales representative of the Central Electric Company, has been appointed sales engineer. Roy N. Baker, railroad sales representative of the Central Electric Company, has been appointed sales engineer. L. R. Mann, sales representative of the Central Electric Company, with headquarters at St. Louis, has been appointed manager of the St. Louis office. Joseph O'Brien, railroad sales representative of the Central Electric Company, has been appointed sales representative, with headquarters in Chicago. C. E. Brown, Jr., country sales manager of the Central Electric Company, has been appointed manager of the light and power department.

Manning, Maxwell & Moore, Inc., New York, has made the following changes in personnel in its sales organization, machinery department: Joseph Wainwright, district sales manager at Philadelphia, Pa., has been appointed eastern sales manager, with headquarters at New York; D. M. McDowell has been transferred from the New York office to the Philadelphia office as acting district sales manager; W. A. Deems, formerly master mechanic, Baltimore & Ohio Railroad, has been appointed sales engineer to cover eastern and southeastern territories. A new sales office has been opened at Los Angeles, Cal., with J. Fontes in charge of that office. Thomas A. Rees, formerly with Motch & Merryweather and the Treadwell Engineering Company, is now salesman at the Pittsburgh office. James W. Barr, formerly with the American Tool Works and the Van Dyck-Churchill Company, and Herbert S. Lester, formerly with the Hendey Machine Company, are now salesmen at the New York office. The sales force at the Buffalo office has been increased by the addition of C. O. Watson, formerly of Syracuse, and Henry I. Knickerbocker has been appointed general office manager, machinery department, in the New York office.

The Superfuel Corporation, New York, has been organized and has acquired control of the stock of the Trent Process Corporation, which owns the United States and foreign patent rights to the process of manufacturing an amalgam of fuel oil and bituminous or pulverized anthracite coal, which eliminates to a large extent the ash and clinker forming content of the coal. This product is now produced by several companies operating under license. Guy M. Standifer, identified with Pacific coast shipbuilding interests, has been elected president, and Francis R. Wadleigh, formerly United States fuel distributor, and commercial engineer of the U. S. Department of Mines and head of the Coal Division of the U. S. Department of Commerce, has been elected vice-president and general manager. J. A. Vandegrift, president of the Slope Mountain Coal Company, is also a vice-president, and Frank R. Peyton, secretary and treasurer of the Trent Process Corporation, is secretary and treasurer. In addition to Messrs. Standifer, Wadleigh and Vandergrift, the following have been elected as directors: Charles M. Barnett, president, Clinchfield Navigation Company, New York; R. M. Atwater, Jr., consulting engineer, New York; Walter E. Trent, combustion engineer, Washington, D. C., and Charles L. Parmelee, consulting engineer, New York.

F. A. Merrick, vice-president and general manager of the Canadian Westinghouse Company, has been elected vice-president and general manager of the Westinghouse Electric & Manufacturing Company. He will have general executive charge of the activities of the parent company, with offices at East Pittsburgh, Pa. The office of President E. M. Herr has been moved to the Westinghouse building, New York. Frank A. Merrick received his technical education at Lehigh University. Shortly after graduation he served with the Steel Motors Company, a subsidiary of the Lorraine Steel Company, and later became chief engineer. He subsequently joined the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa., where he had charge of the production of street railway motors and after the formation of the Canadian Westinghouse, Ltd., in 1903, he was its superintendent, and later became manager of works and finally vice-president and general manager. During the war Mr. Merrick had charge of the factory of the New England Westinghouse Company, which was engaged in turning out rifles for the Russian government, and later supplying the United States with machine guns. After the war Mr. Merrick was located in London for two years as special representative of the Westinghouse Electric International Company, and then returned to Canada to resume his original duties as vice-president and general manager

Trade Publications

Pipe threading machines.—The characteristic features of Williams pipe threading machines are listed in a bulletin recently issued by the Williams Tool Corporation, Erie, Pa.

Chain block.—The Morris worm-gear chain block built for loads of 2,240 lb. to the ton, is described in a six-page, illustrated folder issued by Herbert Morris, Inc., Buffalo, N. Y.

Mono-rail cable conveyor.—A six-page, illustrated folder descriptive of the newly designed American mono-rail cable conveyor for handling coal, has been issued by the Conveyors Corporation of America, Chicago.

Steel mine timber.—Tables and data on the properties and uses of mine timber sections are included in the 46-page booklet descriptive of steel mine timber, which has been issued by the Carnegie Steel Company, Pittsburgh, Pa.

Machine tools.—A four-page guide for the selection of a variety of makes, types and sizes of re-manufactured machine tools, has been issued by Hill, Clarke & Company, Chicago. About 2,000 machines, including lathes, drills, boring machines, planers, millers, etc., are listed.

Fabroil gears.—The General Electric Company, Schenectady, N. Y., has issued a four-page folder descriptive of fabroil gears which have been designed to cushion transmission shocks and to eliminate the noise incident to the operation of machines equipped with metallic gears.

Portable electric hoists.—Bulletin 76-E, descriptive of single drum and double drum portable electric hoists, which are modeled on the turbinair compressed air hoists of similar type and are interchangeable in operation and many particulars of design and construction, has been issued by the Sullivan Machinery Company, Chicago, Ill.

Compressed air equipment.—A 16-page booket, entitled "You Can Do It Quicker with Air," has been issued by the Sullivan Machinery Company, Chicago. Steel work riveting, wood and metal drilling, spray painting and other compressed air operations are featured, as well as the portable air compressors and air equipment used in the performance of this work.

Engineering achievements.—An attractive 52-page brochure, Publication No. 1717, entitled "The Engineering Achievements of the Westinghouse Electric Company during 1924," has been issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. As the name implies, the publication is a record of many of the major achievements of Westinghouse engineers in various fields, including railway traction.

Welding and cutting apparatus.—Welding and cutting apparatus manufactured by the Burdett Oxygen & Hydrogen Company, Chicago, and sold under the trade name "Burco" is described in a new 32-page catalogue issued by this company. The catalogue describes both oxy-acetylene and oxy-hydrogen welding and cutting apparatus and explains in detail the function of the Burco multiple mixer in promoting efficient flame propagation. Different types of torches with their respective parts are shown, also regulators and tank connections. Two full-page illustrations of particular interest to railroad men show the use of a Burco welding torch in building vestibules for passenger coaches and a cutting torch used in scrapping car frames.

The chilled iron car wheel.—A 68-page book, the object of which is to disseminate information as to the manufacture and service of car and locomotive wheels has been published by the Association of Manufacturers of Chilled Car Wheels, Chicago. The superior qualities of the chilled wheel are pointed out and discussed in detail. The various methods and operations used in manufacturing car wheels followed by a technical discussion of the various methods of inspecting and testing car wheels are thoroughly discussed. The importance of the proper machining and mounting of the wheels is emphasized. The various defects which the wheels develop while in service and the agencies for improving the manufacture of chilled car wheels are two factors discussed at length. The subject matter is well illustrated.

Personal Mention

General

D. S. Ellis has been appointed assistant engineer of the New York Central, succeeding W. L. Lentz.

E. P. Moses has been promoted to general equipment inspector (rolling stock) of the New York Central.

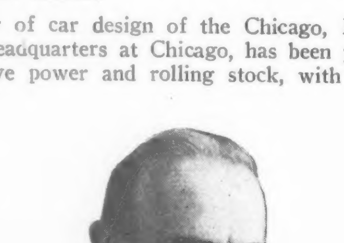
J. E. Ennis has been appointed general equipment inspector (motive power) of the New York Central.

E. H. Trottnow has been appointed assistant engineer of rolling stock of the New York Central, succeeding E. P. Moses.

W. S. Lammers has been appointed assistant valuation engineer of the Atchison, Topeka & Santa Fe, with headquarters at Topeka, Kan., succeeding F. H. Adams.

W. L. Lentz, assistant engineer, has been promoted to engineer of motive power of the New York Central, with headquarters at New York, succeeding P. W. Kiefer.

K. F. Nystrom, engineer of car design of the Chicago, Milwaukee & St. Paul, with headquarters at Chicago, has been promoted to engineer of motive power and rolling stock, with the same headquarters, a newly created position. Mr. Nystrom was born in Sweden in September, 1881, and graduated from a university in that country in 1904 as a mechanical engineer. He came to the United States in November, 1905, and was employed as a draftsman by the Pressed Steel Car Company in 1906. In February, 1909, he was employed by the engineering department of the Pullman Company. In September of the same year he entered the service of the Southern Pacific. He was appointed assistant mechanical engineer of the American Car & Foundry Company in June, 1911, and in July, 1912, was appointed mechanical engineer of the Acme Supply Company of Chicago. Mr. Nystrom re-entered railway service in September, 1913, when he was appointed chief draftsman in the car department of the Grand Trunk at Montreal, Que. He was appointed chief draftsman on the Canadian Pacific in November, 1918, returning to the Grand Trunk in January, 1920, to become engineer of car construction. Mr. Nystrom entered the service of the Chicago, Milwaukee & St. Paul in January, 1922, as engineer of car design.



K. F. Nystrom

F. H. Adams, assistant valuation engineer of the Atchison, Topeka & Santa Fe, has been promoted to mechanical valuation engineer, with headquarters at Topeka, Kan., a newly created position.

N. J. Boughton, engineer of tests of the Missouri-Kansas-Texas, with headquarters at Parsons, Kan., has been promoted to mechanical engineer, with the same headquarters, succeeding B. B. Milner, resigned.

P. W. Kiefer, engineer of motive power of the Lines East and West of Buffalo of the New York Central, with headquarters at New York, has been promoted to engineer of rolling stock, with the same headquarters, succeeding F. S. Gallagher, deceased.

T. M. Kirkby, mechanical assistant to the general superintendent of motive power of the Chicago, Milwaukee & St. Paul, with headquarters at Chicago, has been promoted to special representative with the same headquarters. Mr. Kirkby was born in Norway on July 4, 1883, and graduated from the University of Christiania. He has been employed in various capacities on the Chicago, Milwaukee & St. Paul since 1905, with the exception of the period from 1911 to 1916, when he worked in the mechanical department of the Duluth & Iron Range at Two Harbors, Minn., as draftsman. He returned to the Chicago, Milwaukee & St. Paul in July, 1916, as draftsman in the mechanical engineer's office, with headquarters at Milwaukee, Wis., being subsequently promoted to chief draftsman in 1918, shop schedule engineer of the Milwaukee shops in 1920, and mechanical assistant to the general superintendent of motive power, with headquarters at Chicago, on January 1, 1922. He held the latter position until his recent promotion as special representative to the general superintendent of motive power.

Master Mechanics and Road Foremen

George E. Dougherty has been appointed master mechanic of the Buffalo division of the Delaware, Lackawanna & Western, with headquarters at East Buffalo, N. Y.

J. J. Keller has been appointed assistant master mechanic of the Salt Lake division of the Southern Pacific, with headquarters at Sparks, Nev., succeeding J. E. Stone.

J. E. Morris, general foreman of the Florida East Coast, has been appointed master mechanic, with headquarters at New Smyrna, Fla. This is a newly created position.

W. W. Jones, Jr., general foreman of the Florida East Coast, has been promoted to master mechanic, with headquarters at Buena Vista, Fla. This is a newly created position.

J. E. Stone, assistant master mechanic of the Salt Lake division of the Southern Pacific, with headquarters at Sparks, Nev., has been promoted to master mechanic of the Salt Lake division, with headquarters at Ogden, Utah, suceeding D. Hickey, who has retired.

W. C. Milar, night foreman of the Eola roundhouse of the Chicago, Burlington & Quincy, has been appointed road foreman of engines, with headquarters at Aurora, Ill., succeeding J. S. Ford, whose appointment as assistant master mechanic of the Galesburg division was noted in the January issue of the *Railway Mechanical Engineer*.

Car Department

F. Suddeth has been promoted to night foreman of the Atchison, Topeka & Santa Fe, succeeding M. L. Hartigan.

William Govert has been appointed master car builder of the Gary division of the Elgin, Joliet & Western, with headquarters at Kirk yard, Gary, Ind.

A. L. Merrill, car foreman of the Atchison, Topeka & Santa Fe, at Argentine, Kan., has been promoted to a similar position, with headquarters at Emporia, Kan.

R. B. Craig has been appointed general car foreman of the Atchison, Topeka & Santa Fe, with headquarters at Chanute, Kan., succeeding L. H. Klein, who has retired.

M. L. Hartigan, night foreman of the Atchison, Topeka & Santa Fe, has been promoted to car foreman, with headquarters at Argentine, Kan., succeeding A. L. Merrill.

Shop and Enginehouse

P. P. Curto, day roundhouse foreman of the Atchison, Topeka & Santa Fe, with headquarters at Gallup, N. M., has been promoted to division foreman.

E. J. Cyr, day foreman of the Eola roundhouse of the Chicago, Burlington & Quincy, has been appointed general foreman, with headquarters at Centralia, Ill.

Ralph Wilson has been transferred from Richmond, Cal., to Gallup, N. M., as day roundhouse foreman of the Atchison, Topeka & Santa Fe, succeeding P. P. Curto.

P. P. Hettinger, roundhouse foreman of the Chicago, Burlington & Quincy, with headquarters at Aurora, Ill., has been promoted to foreman of the Eola roundhouse, succeeding E. J. Cyr.

G. V. Hemmer, assistant supervisor of production of the Chicago, Burlington & Quincy, at Chicago, has been promoted to roundhouse foreman, with headquarters at Aurora, Ill., succeeding P. P. Hettinger